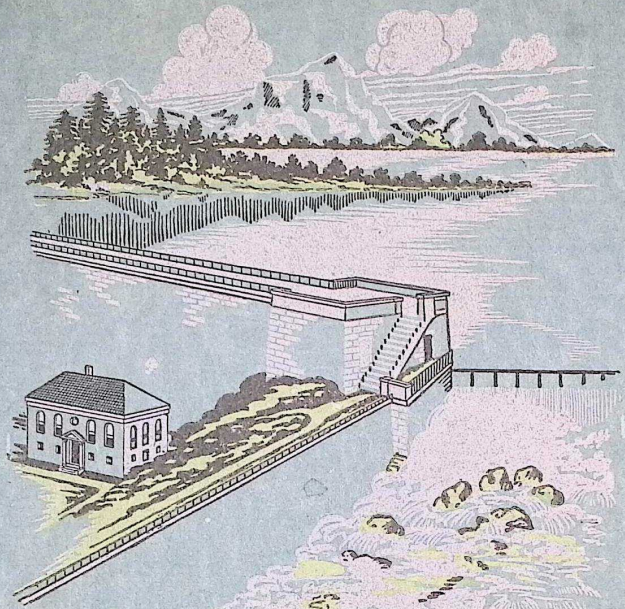
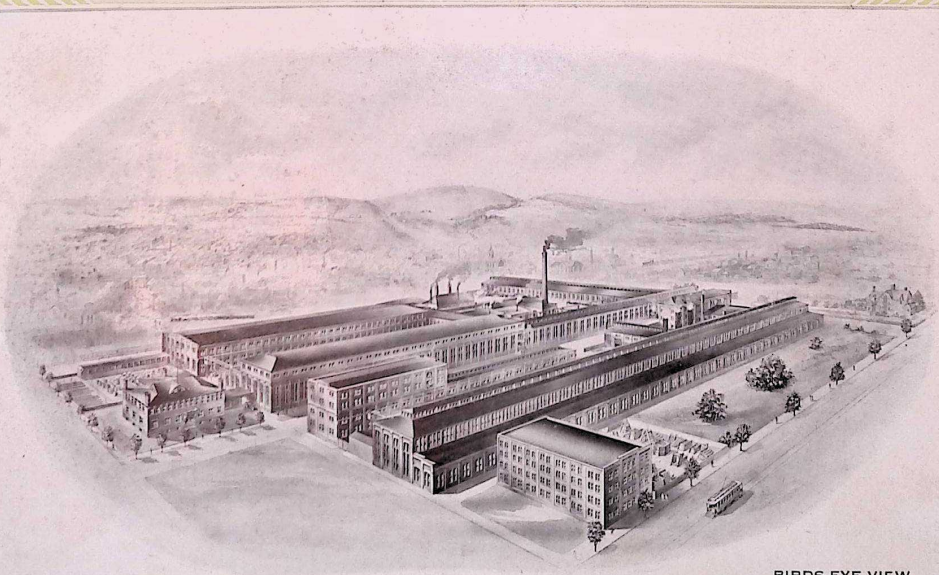
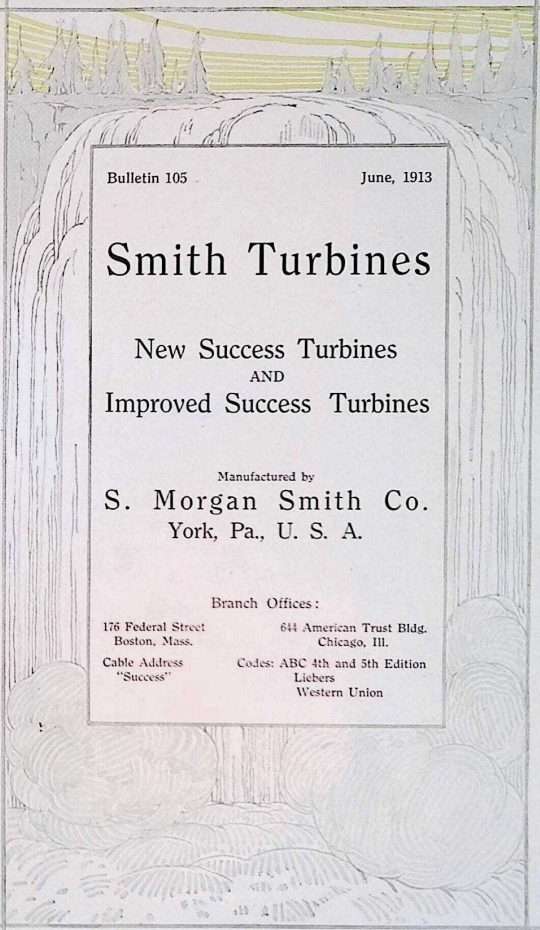


HYDRAULIC TURBINES



BIRDS-EYE VIEW
OF OUR WORKS



Bulletin 105 June, 1913

Smith Turbines

New Success Turbines
AND
Improved Success Turbines

Manufactured by

S. Morgan Smith Co.
York, Pa., U. S. A.

Branch Offices:

176 Federal Street
Boston, Mass.

644 American Trust Bldg.
Chicago, Ill.

Cable Address
"Success"

Codes: ABC 4th and 5th Edition
Liebers
Western Union

Copyright, 1913, by S. Morgan Smith Co.

PREFACE

IN presenting this Bulletin to the public, we desire to call attention to the fact that while we have only published tables of power and speed of the well-known Smith, New Success and Improved Success turbines, we are building others of greater power and higher speed than the Smith, and also continue to build the well-known McCormick turbine. We also build Francis turbines to operate under heads up to 650 feet. We have hundreds of patterns of special capacity turbines which we have not tabled. Should the standard patterns as tabled in this Bulletin not meet requirements, our engineers are prepared to design turbines that will. Therefore, we suggest that people having water-powers to develop, or those who may be considering a change in their present equipment, write us stating the head under which turbines are to operate, the amount of power desired, and the water available; also the kind of machinery to be driven. We will then select turbines to meet the requirements.

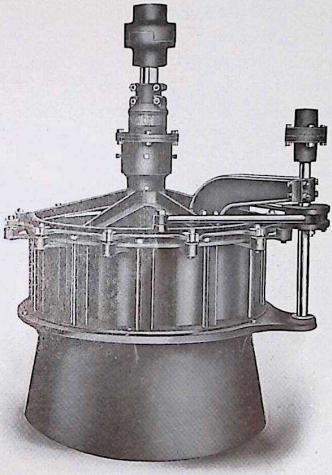
We also call attention to the fact that all guarantees for power and speed of turbines of our manufacture are based on tests of turbines of similar design made in the testing flume of the Holyoke Water Power Company, Holyoke, Massachusetts. We suggest that before selecting turbines, purchasers satisfy themselves that those they are considering have been tested at the Holyoke testing flume and give the efficiency, power and speed

guaranteed. We have spared no expense in developing turbines, which, while simple in design, give high efficiency, speed and enormous power. It is often found that the slower speed turbines, such as the New and Old Success, are better suited for meeting existing conditions. We are prepared to furnish both the Smith and the New Success turbines fitted with either cylinder or wicket gates. The Improved Success is fitted with wicket gates only.

Our works, located directly on the lines of the Pennsylvania and Western Maryland Railroads, are equipped with modern tools and specially arranged for the handling of heavy machinery.

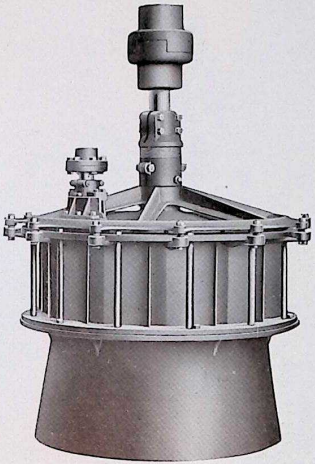
Those contemplating the purchase of turbines and machinery will find it to their interest to correspond with us, and, if possible, call at the main office and go through our works. We will guarantee results when our instructions are followed.

S. MORGAN SMITH CO.



Engraving No. 310

Represents a Vertical Smith Wicket Gate Turbine fitted with our patented bronze block gate operating mechanism, and with quarter box and safety step on the dome. The gate ring is operated by push and pull rods instead of gears.

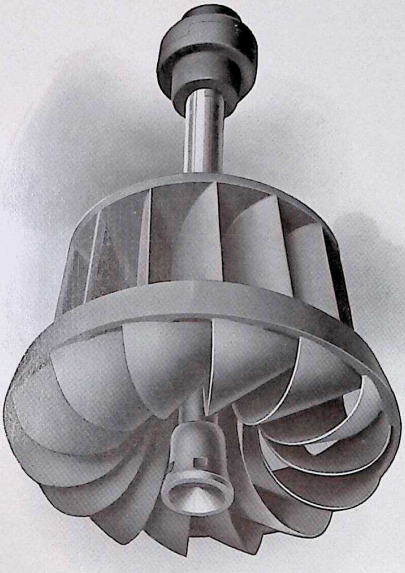


Engraving No. 311

Represents a Standard Smith Wicket Gate Turbine. All prices quoted are for turbines of this design unless otherwise specified. Turbines larger than 24" will be shipped in sections for convenience in handling.

Prices on both Horizontal and Vertical Shaft Turbines will be quoted on application.

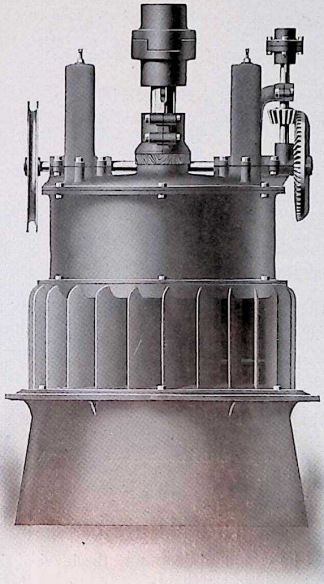
When comparing cost of different makes of Turbines do not fail to also compare the power and speed.



Engraving No. 312

Represents a standard Smith runner with its shaft, coupling and cast iron step shoe. These runners are made either of solid cast iron or bronze by means of cores, or can be made with plate steel buckets securely connected to a cast iron hub and band. Attention is called to the openings for water cooling above the turned concave of the step shoe.

Smith Cylinder Gate Turbine



Engraving No. 313

On account of the simplicity of the Cylinder Gate some people have a preference for that type of turbine, and to meet this demand we build a line of Smith Turbines equipped with Cylinder gates, as shown above. With this type of gate, the turbine develops the same power and speed as the Standard Smith Wicket Gate Turbine and very high efficiency. This is the only Cylinder gate turbine the gate shaft of which can be removed without disturbing the dome lid. The value of this improvement is appreciated when the spur pinions and racks which move the gate must be replaced.

Directions for the Construction of Head and Tail Races

THE HEAD RACE

In constructing the canal or head race, a very frequent error is committed by failing to give it sufficient capacity. It should be wide and deep, and especially where the race is of considerable length, and a large quantity of water is to pass through it. As a general rule, the water should not flow faster than from 60 to 120 feet per minute. Where there is a long race, after the turbine has been running three or four hours the head frequently draws down from one to three feet. The effect of this is the same as if the dam had been lowered an equal distance—resulting in a loss of power, which would have been prevented by making the race as wide and deep as it should be.

When the water is to be conveyed through pipes to the turbines operating under low heads, the receiving ends of the pipes should be well submerged so as to prevent any possibility of their drawing air. The diameter of the pipe to be recommended varies according to the quantity of water, length and contour of the pipe, head of water acting on the turbine and the head loss permissible due to friction. See table giving the loss of head in pipes of different sizes at various velocities on pages 66 and 67.

THE TAIL RACE

This should be wide and deep, and the level of the bottom of the wheel pit should be carried from ten to forty feet below the end of flume, depending upon the amount of water discharged by the turbine, and if possible it should be carried out to the bed of the stream, as no tail race for even small turbines should have less than two feet of dead water in it before the turbines are put in motion, and where large turbines (using considerable water) are to be used, the tail race should have three or four feet of dead water in its entire length. By having the tail race thus constructed, as soon as the water is discharged from the turbines, it will push out or displace the dead water in the race, thus preventing a loss of head. For instance, to be more explicit, suppose the bottom of tail race is on a level with the water in main stream into which the tail race discharges, when

the turbines are started the water in tail race would rise in proportion to the width of the race and the quantity of water flowing therein, and reduce the working head in proportion; while if the race were as first above stated, the water from the turbines would displace the dead water without rising above the water in the main stream, thus utilizing the full amount of head. From one to three feet of working head is often lost for want of proper depth and width of tail gate.

WHEEL PIT

Here is where mill owners and millwrights, in putting in turbines are more liable to err than elsewhere. Whether under high or low heads, the pit should be deep and wide. There is no case where this is more important than where a large turbine is run under a low head; as under these circumstances it is not desirable to lose any head whatever. A pit of insufficient size causes the water to react upon the turbine, and an additional loss of power is also caused by the fact that a portion of the head is consumed in forcing the water out of the pit when there is not sufficient outlet. As a rule, the depth of the pit should not be less than the diameter of the lower end of the draft tube.

Water has but 100 per cent. in it, and a turbine that takes out from 80 to 90 of that per cent. leaves but little force in it. To expect that the water coming through our turbines will have power to wash the sand and gravel out of their own pit, is to expect what will not be realized. Hence in putting in turbines, do not calculate upon the water in the wheel pit to do any work. If you find it foaming and dashing in the pit, then rest assured that the pit is either too shallow or too narrow, or both.

SETTING TURBINES ABOVE TAIL WATER

Sometimes in adapting turbines to high and even low heads, it becomes necessary to set the turbines some distance above the tail water and conduct the water from them through draft tubes. Better results may be obtained when turbines are set in this manner than if placed close to the tail water, provided the draft tubes are air tight and their discharge ends properly submerged. In all cases when draft tubes are used, they should be made of steel or concrete.

Directions for Setting Wheels

In setting turbines of our manufacture in a wooden penstock, the first thing to do is to see that the floor of the flume is level. Generally a ring made of soft wood is placed on the floor around the hole, on which the draft tube flange of the wheel, which is faced off, is set. It is very important that the flume be built on good foundations so as not to settle when the water is let in; a very good plan, and especially where large turbines are to be set, is to put four posts or iron columns under the timbers around the hole in the floor through which the draft tube passes.

The step and all bearings of the turbines are carefully adjusted before leaving the shops.

When turbines are shipped "knocked down," the draft tube should always be set in position first, then the runner or wheel proper placed on the step, then set the case and so on until all parts are together. When the step is properly adjusted, there will be a space between the top of the band of the runner and the bottom or inner edge of the bottom plate of 1/32". When the turbines are not to be run for some time, the step shoes should be well covered with tallow to prevent rusting.

WARRANTY

Turbines installed in accordance with our instructions and operated at speeds recommended by us, for each installation, failing to give the power guaranteed by us, can be returned if not broken, to the station to which they were shipped any time within thirty days, and the money received for such wheels will be refunded. If purchaser finds it impossible to put the turbine in and give it a trial within the thirty days allotted, and wants more time it will be granted on application, not exceeding in all sixty days from date of shipment.

S. MORGAN SMITH COMPANY.

Test and Tables of Turbines

The tables of the turbines of our manufacture are based on actual tests made in the Holyoke Testing Flume—**the only reliable testing flume in the country.** Both right and left hand turbines have been tested and brought to over 80 per cent. efficiency. Although our tables are only based on 80 per cent. useful effect from the water used, all of the turbines have exceeded 80 per cent. in the tests, **some sizes having given over 90 per cent. at less than full gate with very high average from half to full gate.**

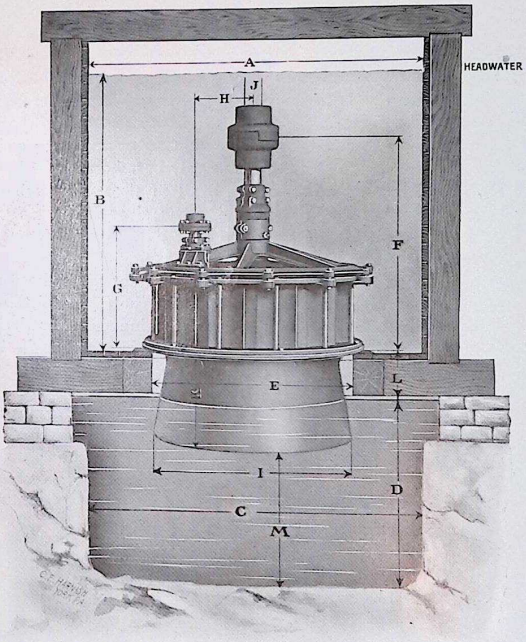
When comparing the tables of our turbines with those of other manufacturers, satisfy yourself that the tables of those turbines are reliably made. Many turbine builders have tabled their turbines at 80 or even 90 per cent, when if the truth were known, their turbines in actual test would not exceed 60 to 70 per cent.

Before purchasing a turbine be assured that the tables of the particular size turbine you require are based on actual tests made in the new flume of the Holyoke Water Power Company. Water powers are becoming more valuable each year, and the owners of water powers cannot afford to run turbines which sacrifice water and give but little power.

The following rule will enable you to determine the percentage at which any turbine is tabled.

RULE

Multiply the cubic feet of water by 62½, which is the weight of one cubic foot of water; multiply the product by the head, which will give the foot pounds; divide that product by 33,000, which gives the full horse-power of the water; divide the horse-power claimed by the full horse-power of the water, and the result will be the percentage at which the turbine is tabled.



Engraving No. 314

Shows a Smith Wicket Gate Turbine in a wooden flume. See dimensions on page 15.

Dimensions of Turbines and Penstocks

IN INCHES

Lettered columns correspond with letters in engraving on opposite page.

Dia. Turbine	A	B	C	D	E	F	G	H	I	J	K	L	M
12	42	36	48	32	21	25	14	7	20	2 1/16	9 5/16	5 5/8	26
15	48	42	54	36	26	28	16 3/4	9 1/4	24 15/16	2 3/4	12	6	30
18	54	45	63	41	30 1/2	30	17 31/32	10 15/16	29 1/2	2 7/8	14 1/4	8 1/4	35
21	63	48	72	46	35 1/2	35	21 7/8	12 15/16	34 1/4	3 1/16	16 1/2	10 1/2	40
24	72	52	84	51	39	40	23	14 3/8	38	3 3/16	18	12	45
27	84	56	90	57	43	42	25 15/16	16 1/4	42	3 3/8	19	12	50
30	90	60	102	63	47	49	28	18 1/2	45 3/4	3 7/8	20 1/2	12 1/2	55
33	102	64	108	68	52	54	31 5/8	21 1/8	50 3/8	4 1/8	23	15	60
36	108	68	120	73	57	54 1/2	32 3/4	23	56	4 3/8	25	16	64
39	120	72	126	77	61 1/2	55	34	24 3/4	60 1/2	5 1/8	27	18	68
42	126	76	138	81	65 1/2	61	37	26	64 1/8	5 3/8	28 3/4	19 3/4	72
45	138	80	144	86	70 1/2	66	38 5/8	28	69 1/2	5 7/8	31 3/4	21 3/4	76
48	144	84	153	90	75 1/2	72	40 3/8	29 3/4	74	6 3/8	34 3/4	24 3/4	80
51	153	88	162	97	79	76	43 7/8	31 3/4	78 1/2	6 7/8	37	26	86
54	162	92	168	104	84	80	45 1/4	33	82 1/2	7 1/8	39	27	92
57	168	96	180	110	87	84	48 5/8	. . . .	85 1/2	7 7/8	41	29	98
60	180	100	192	118	93	87	51 3/8	. . . .	91 1/8	7 7/8	43	31	106
63	192	104	204	124	98	90	53 3/4	. . . .	96 5/8	7 7/8	44 1/2	32 1/2	112
66	204	108	214	130	103	93	56 3/8	. . . .	102 5/8	7 7/8	46	34	118
69	208	110	220	133	106	94	59	. . . .	105 5/8	7 7/8	47	35	121
72	214	112	226	136	110 1/2	96	61 1/2	. . . .	108 5/8	7 7/8	48	36	124

Some of the Most Important Advantages of the Smith Turbine

It develops the largest amount of power for a given amount of water of any turbine manufactured.

It will not clog with trash, as anything that will pass through the gates will pass through the runner.

It runs at the highest speed ever attained by a turbine, thus avoiding the necessity of gearing up when driving fast running machinery.

It develops enormous power for its diameter, thus reducing the cost of flumes.

It is so constructed that there is very little pressure on the steps.

Its gates are practically balanced, thus requiring a minimum effort to control same.

It has proven its superiority by actual tests in the Holyoke testing flume.

WE BUILD TURBINES OF GREATER CAPACITY THAN THE FOLLOWING TABLES

Diameter of Wheel in Inches.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.													
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
12	Horse Power	1.7	2.7	3.7	4.9	6.2	7.6	9.1	10.6	12.3	14.0	15.8	17.7	19.6	21.6	23.7
	Cubic Feet	370	441	483	533	579	621	660	693	731	762	794	826	853	882	911
	Revolutions	240	277	310	340	367	392	416	438	460	480	500	519	537	554	572
15	Horse Power	2.7	4.2	5.9	7.8	9.8	12.0	14.4	16.8	19.4	22.1	25.0	27.9	31.0	34.1	37.4
	Cubic Feet	488	686	771	850	915	980	1045	1098	1153	1204	1257	1303	1351	1393	1438
	Revolutions	192	222	248	271	293	314	333	351	368	384	400	416	430	444	457
18	Horse Power	3.9	6.0	8.5	11.1	14.0	17.2	20.5	24.0	27.7	31.6	35.6	39.8	44.1	48.6	53.3
	Cubic Feet	750	980	1111	1209	1307	1405	1489	1569	1646	1721	1790	1858	1921	1985	2049
	Revolutions	160	185	207	226	244	261	277	292	306	320	333	346	358	370	381
21	Horse Power	5.3	8.2	11.5	15.2	19.1	23.3	27.9	32.7	37.7	43.0	48.4	54.1	60.0	66.2	72.5
	Cubic Feet	1155	1340	1503	1655	1783	1903	2026	2135	2240	2342	2433	2526	2614	2704	2788
	Revolutions	137	158	177	194	210	224	238	251	263	274	285	296	307	317	327
24	Horse Power	7.0	10.8	15.1	19.8	25.0	30.6	36.5	42.7	49.3	56.2	63.4	70.8	78.6	86.6	94.8
	Cubic Feet	1525	1765	1974	2156	2334	2500	2651	2791	2929	3061	3188	3306	3426	3537	3645
	Revolutions	120	139	155	170	183	196	208	219	230	240	250	259	268	277	286
27	Horse Power	8.9	13.6	19.1	25.1	31.7	38.7	46.2	54.1	62.4	71.1	80.2	89.6	99.4	109.5	119.9
	Cubic Feet	1939	2222	2497	2734	2960	3162	3355	3535	3708	3873	4032	4183	4331	4472	4610
	Revolutions	107	123	138	151	163	174	185	195	204	213	222	231	239	247	254
30	Horse Power	10.9	16.9	23.6	31.0	39.1	47.8	57.0	66.8	77.1	87.8	99.0	110.7	122.7	135.2	148.1
	Cubic Feet	2375	2761	3085	3377	3651	3905	4139	4366	4581	4782	4978	5168	5346	5521	5695
	Revolutions	96	111	124	136	147	157	166	175	184	192	200	207	215	222	229
33	Horse Power	13.2	20.4	28.6	37.6	47.3	57.9	69.0	80.9	93.3	106.3	119.9	134.0	148.6	163.7	179.3
	Cubic Feet	2876	3333	3738	4101	4421	4728	5010	5287	5543	5787	6028	6256	6474	6686	6894
	Revolutions	87	101	113	123	133	143	151	159	167	175	182	189	196	202	208
36	Horse Power	15.8	24.3	33.9	44.8	56.4	68.9	82.2	96.3	111.1	126.6	142.8	159.6	177.0	195.0	213.5
	Cubic Feet	3442	3971	4431	4880	5266	5629	5969	6294	6601	6896	7180	7452	7712	7964	8209
	Revolutions	80	92	103	113	122	131	140	147	154	160	167	173	179	185	191
39	Horse Power	19.5	28.5	39.9	52.5	66.1	80.8	96.4	112.9	130.3	148.5	167.4	187.1	207.5	228.6	250.4
	Cubic Feet	4248	4657	5216	5719	6172	6601	7001	7379	7742	8089	8417	8736	9041	9336	9628
	Revolutions	74	85	95	104	113	121	128	135	141	148	154	159	165	171	176

WE ALSO BUILD REDUCED CAPACITY TURBINES

Tables of Smith Turbines

TURBINES OF INCREASED POWER AND SAME SPEED CAN BE FURNISHED

Diameter of Wheel in inches.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.														
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
42	Horse Power	21.5	33.1	46.3	60.8	76.7	93.7	111.8	131.0	151.1	172.2	194.2	217.0	240.7	265.1	290.4
	Cubic Feet	4684	5408	6052	6623	7151	7655	8119	8562	8978	9381	9764	10133	10487	10827	11166
	Revolutions	69	79	88	97	105	112	119	125	131	137	143	148	153	158	163
45	Horse Power	24.7	38.0	53.1	69.8	88.0	107.5	128.3	150.3	173.3	197.5	222.7	248.9	276.1	304.1	333.1
	Cubic Feet	5381	6209	6941	7603	8217	8783	9317	9837	10297	10758	11187	11621	12030	12419	12808
	Revolutions	64	74	83	91	98	105	111	117	123	128	133	138	143	148	152
48	Horse Power	27.8	42.9	59.9	78.8	99.2	121.3	144.7	169.5	195.6	222.8	251.3	280.9	311.5	343.2	375.8
	Cubic Feet	6057	7010	7831	8584	9262	9910	10508	11068	11622	12136	12635	13115	13572	14016	14450
	Revolutions	60	69	77	85	92	98	104	110	115	119	124	129	134	139	143
51	Horse Power	31.7	48.8	68.3	89.8	113.2	138.3	165.0	193.2	222.9	254.0	286.4	320.1	355.0	391.1	428.3
	Cubic Feet	6906	7974	8928	9782	10569	11308	11982	12629	13245	13835	14400	14945	15467	15972	16488
	Revolutions	56	65	73	80	86	92	98	103	108	113	118	122	126	130	134
54	Horse Power	35.6	54.8	76.5	100.6	126.8	155.0	184.9	216.6	249.8	284.7	321.0	358.8	397.9	438.4	480.1
	Cubic Feet	7756	8954	10000	10958	11839	12663	13427	14157	14843	15508	16140	16752	17336	17904	18480
	Revolutions	53	62	69	75	81	87	92	97	102	107	111	115	119	123	127
57	Horse Power	39.6	61.0	85.3	112.1	141.3	172.7	206.0	241.3	278.4	317.2	357.7	399.8	443.4	488.5	535.0
	Cubic Feet	8627	9967	11150	12211	13193	14110	14959	15771	16543	17278	17988	18667	19319	19950	20570
	Revolutions	51	58	65	71	77	83	88	93	97	101	105	109	113	117	121
60	Horse Power	43.9	67.6	94.5	124.2	156.6	191.4	228.3	267.4	308.5	351.5	396.4	443.0	491.3	541.2	592.8
	Cubic Feet	9564	11046	12353	13529	14622	15637	16579	17477	18331	19146	19931	20683	21406	22106	22793
	Revolutions	48	55	62	68	73	78	83	88	92	96	100	104	108	111	114
63	Horse Power	48.4	74.5	104.2	137.0	172.7	211.0	251.7	294.8	340.1	387.5	437.0	488.4	541.6	596.7	653.5
	Cubic Feet	10545	12173	13621	14923	16125	17239	18278	19268	20209	21107	21972	22792	23597	24369	25117
	Revolutions	46	53	59	65	70	75	79	84	88	92	95	99	103	106	109
66	Horse Power	53.1	81.8	114.4	150.3	189.5	231.5	276.3	323.5	373.3	425.3	479.6	536.0	594.4	654.9	717.2
	Cubic Feet	11569	13366	14954	16372	17694	18914	20065	21146	22181	23166	24114	25026	25898	26746	27566
	Revolutions	44	50	56	62	67	71	76	80	83	87	91	94	97	101	104
72	Horse Power	63.2	97.4	136.1	178.9	225.5	275.6	328.8	385.1	444.2	506.2	570.8	637.9	707.5	779.4	853.6
	Cubic Feet	13769	15915	17791	19487	21055	22516	23877	25170	26394	27573	28700	29783	30826	31830	32821
	Revolutions	40	46	52	57	61	66	70	73	77	80	83	86	89	92	95

SPECIAL TURBINES DESIGNED FOR ANY HEAD

Tables of Smith Turbines

IF THE TURBINES TABLED ARE NOT POWERFUL ENOUGH OUR NEW TURBINES WILL BE

Diameter of Wheel in Inches	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.														
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
12	Horse Power	25.8	28.0	30.2	32.5	34.9	37.3	39.7	42.2	44.8	47.4	50.1	52.8	55.5	58.3	61.2
	Cubic Feet	937	963	987	1011	1037	1060	1081	1103	1126	1147	1169	1190	1209	1229	1250
	Revolutions	588	604	620	635	650	665	679	693	707	720	733	746	759	772	784
15	Horse Power	40.7	44.2	47.7	51.3	55.0	58.8	62.7	66.7	70.7	74.9	79.1	83.3	87.7	92.1	96.6
	Cubic Feet	1478	1520	1559	1596	1634	1671	1707	1744	1777	1813	1846	1878	1911	1941	1972
	Revolutions	470	483	496	508	520	532	543	554	565	576	587	597	607	617	627
18	Horse Power	58.0	62.9	68.0	73.1	78.4	83.8	89.4	95.0	100.8	106.6	112.6	118.7	124.9	131.1	137.6
	Cubic Feet	2106	2164	2222	2275	2329	2382	2435	2484	2534	2581	2628	2675	2722	2764	2810
	Revolutions	392	403	413	423	433	443	453	462	471	480	489	498	506	515	523
21	Horse Power	79.0	85.6	92.5	99.5	106.7	114.0	121.6	129.2	137.1	145.1	153.2	161.5	169.9	178.5	187.2
	Cubic Feet	2868	2944	3023	3096	3170	3240	3311	3377	3446	3513	3576	3640	3702	3760	3822
	Revolutions	336	345	354	363	372	380	388	396	404	412	420	427	434	441	448
24	Horse Power	103.3	112.0	121.0	130.3	139.6	149.2	159.0	169.1	179.4	189.8	200.4	211.3	222.3	233.5	244.9
	Cubic Feet	3751	3853	3954	4055	4148	4240	4330	4420	4510	4595	4677	4763	4844	4922	5000
	Revolutions	294	302	310	318	325	332	339	346	353	360	367	374	380	386	392
27	Horse Power	130.6	141.7	153.0	164.7	176.5	188.7	201.1	213.8	226.8	240.0	253.5	267.2	281.1	295.3	309.7
	Cubic Feet	4742	4874	5000	5125	5244	5363	5476	5588	5702	5810	5917	6023	6125	6226	6324
	Revolutions	261	268	275	282	289	295	302	308	314	320	326	332	337	343	348
30	Horse Power	161.4	174.9	189.0	203.3	218.1	233.1	248.5	264.1	280.2	296.5	313.1	330.0	347.2	364.8	382.6
	Cubic Feet	5860	6016	6176	6327	6480	6625	6767	6903	7044	7178	7308	7438	7565	7690	7813
	Revolutions	235	242	248	254	260	266	272	277	283	288	293	299	304	309	314
33	Horse Power	195.3	211.8	228.8	246.2	263.9	282.1	300.7	319.7	339.1	358.9	379.0	399.5	420.3	441.5	463.0
	Cubic Feet	7091	7285	7475	7661	7840	8017	8188	8356	8524	8688	8845	9004	9158	9305	9454
	Revolutions	214	220	226	231	237	242	247	253	258	263	267	272	277	281	286
36	Horse Power	232.6	252.3	272.5	293.2	314.4	336.1	358.3	380.9	404.0	427.5	451.5	475.9	500.7	526.0	551.6
	Cubic Feet	8446	8679	8905	9124	9340	9552	9756	9957	10156	10350	10538	10727	10910	11088	11263
	Revolutions	196	201	206	211	217	222	227	232	236	240	244	248	253	257	261
39	Horse Power	272.8	295.9	319.5	343.8	368.7	394.1	420.1	446.6	473.7	501.2	529.3	558.0	587.0	616.7	646.8
	Cubic Feet	9905	10179	10441	10699	10954	11200	11439	11674	11909	12134	12354	12577	12791	13000	13208
	Revolutions	181	186	191	195	200	205	209	213	217	222	226	230	234	238	241

FRANCIS TURBINES FURNISHED FOR HEADS UP TO 650 FEET

Tables of Smith Turbines

TURBINES WITH GREATLY INCREASED POWER AND SPEED CAN BE FURNISHED

Diameter of Wheel in Inches	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.														
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
42	Horse Power	316.4	343.1	370.5	398.7	427.5	457.0	487.1	517.9	549.3	581.3	613.8	647.0	680.8	715.1	750.0
	Cubic Feet	11488	11803	12108	12408	12701	12987	13264	13538	13809	14073	14326	14583	14835	15074	15315
	Revolutions	168	173	178	182	186	190	194	198	202	206	209	213	217	221	224
45	Horse Power	362.9	393.6	425.1	457.3	490.4	524.2	558.8	594.1	630.1	666.8	704.2	742.2	780.9	820.3	860.2
	Cubic Feet	13177	13540	13892	14231	14570	14898	15216	15530	15841	16143	16436	16729	17016	17292	17565
	Revolutions	157	161	165	169	173	177	181	185	189	193	196	199	202	206	209
48	Horse Power	409.5	444.1	479.6	516.0	553.3	591.5	630.4	670.3	710.9	752.3	794.5	837.3	881.1	925.5	970.7
	Cubic Feet	14869	15277	15673	16058	16438	16810	17166	17521	17872	18213	18543	18872	19199	19509	19822
	Revolutions	147	151	155	159	163	166	169	173	176	180	183	186	190	193	196
51	Horse Power	466.7	506.2	546.6	588.1	630.6	674.1	718.6	763.9	810.2	857.4	905.5	954.5	1004.2	1054.9	1106.3
	Cubic Feet	16946	17413	17863	18301	18735	19158	19567	19968	20368	20757	21134	21514	21881	22237	22590
	Revolutions	138	142	146	150	153	156	159	163	166	169	173	176	179	182	185
54	Horse Power	523.0	567.3	612.6	659.2	706.8	755.5	805.3	856.2	908.1	961.0	1014.8	1069.7	1125.5	1182.3	1239.9
	Cubic Feet	18990	19515	20020	20514	20999	21471	21928	22371	22829	23266	23685	24111	24524	24923	25318
	Revolutions	131	134	137	140	144	147	150	154	157	160	163	166	169	172	174
57	Horse Power	582.8	632.1	682.6	734.5	787.6	841.9	897.4	954.0	1011.9	1070.8	1130.8	1192.0	1254.1	1317.4	1381.6
	Cubic Feet	21161	21744	22307	22857	23399	23926	24436	24937	25439	25924	26393	26868	27327	27771	28212
	Revolutions	124	127	130	133	136	140	143	146	149	152	155	157	160	163	165
60	Horse Power	645.8	700.4	756.4	813.9	872.7	932.9	994.4	1057.0	1121.2	1186.5	1253.0	1320.8	1389.7		
	Cubic Feet	23449	24094	24719	25328	25928	26513	27077	27630	28187	28725	29245	29771	30281		
	Revolutions	117	121	124	127	130	133	136	139	142	145	147	150	152		
63	Horse Power	712.0	772.2	833.9	897.3	962.1	1028.5	1096.3	1165.5	1236.1	1308.1	1381.5	1456.2	1532.1		
	Cubic Feet	25852	26563	27252	27924	28584	29230	29852	30466	31075	31669	32244	32833	33384		
	Revolutions	112	115	118	121	124	127	129	132	135	138	140	142	144		
66	Horse Power	781.4	847.5	915.2	984.8	1055.9	1128.7	1203.1	1279.1							
	Cubic Feet	28372	29154	29908	30647	31370	32077	32760	33435							
	Revolutions	107	110	113	116	119	121	124	126							
27	Horse Power	930.0	1008.7	1089.2	1172.0	1256.7	1343.3	1431.9	1522.3							
	Cubic Feet	33768	34699	35595	36472	37336	38176	38990	39792							
	Revolutions	98	101	103	106	108	111	113	115							

WE FURNISH LOW SPEED TURBINES WHEN REQUIRED

OUR INCREASED CAPACITY TURBINES WILL MEET CONDITIONS WHEN STANDARD TURBINES DO NOT

Diameter of Wheel in Inches.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.														
		33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
12	Horse Power	64.1	67.0	70.0	73.0	76.1	79.2	82.3	85.5	88.0	91.2	94.5	98.4	101.1	104.4	108.0
	Cubic Feet	1270	1288	1307	1326	1345	1362	1379	1397	1403	1419	1436	1461	1468	1483	1502
	Revolutions	796	808	820	832	843	854	865	876	887	897	908	919	929	939	949
15	Horse Power	101.2	105.8	110.5	115.3	120.1	125.0	130.0	135.0	139.4	144.6	149.8	155.2	160.3	165.7	171.1
	Cubic Feet	2005	2033	2063	2094	2122	2150	2179	2206	2222	2250	2277	2304	2327	2354	2380
	Revolutions	637	647	656	665	675	684	693	701	710	719	728	736	744	753	761
18	Horse Power	144.1	150.7	157.4	164.2	171.1	178.1	185.2	192.3	199.2	206.5	214.0	221.6	229.1	236.7	244.5
	Cubic Feet	2855	2896	2939	2982	3023	3063	3104	3142	3175	3213	3253	3291	3326	3363	3401
	Revolutions	531	539	547	555	562	569	577	584	591	598	605	612	619	626	633
21	Horse Power	196.0	205.0	214.1	223.4	232.8	242.2	251.9	261.6	271.4	281.4	291.5	301.6	312.1	322.6	333.1
	Cubic Feet	3882	3940	3997	4057	4114	4166	4222	4275	4326	4378	4430	4478	4533	4583	4633
	Revolutions	455	462	469	475	482	488	494	500	507	514	520	526	532	538	544
24	Horse Power	256.5	268.2	280.1	292.2	304.5	316.9	329.5	342.3	354.4	367.5	380.7	394.4	407.6	421.3	435.0
	Cubic Feet	5081	5155	5229	5306	5380	5450	5522	5593	5649	5718	5786	5857	5918	5986	6051
	Revolutions	398	404	410	416	422	427	432	437	443	449	454	460	465	470	475
27	Horse Power	324.3	339.2	354.3	369.6	385.1	400.8	416.7	432.8	449.1	465.6	482.3	499.2	516.4	533.7	551.2
	Cubic Feet	6424	6519	6615	6712	6805	6894	6984	7072	7158	7244	7330	7413	7498	7583	7667
	Revolutions	354	359	364	370	375	380	385	390	395	400	404	409	414	418	422
30	Horse Power	400.6	419.0	437.6	456.5	475.7	495.1	514.7	534.7	554.5	574.9	595.6	616.8	637.6	659.0	680.6
	Cubic Feet	7936	8053	8170	8290	8406	8516	8626	8737	8838	8945	9053	9159	9264	9364	9467
	Revolutions	319	323	327	333	337	342	346	351	355	360	364	368	372	376	380
33	Horse Power	484.9	507.1	529.7	552.5	575.7	599.2	623.0	647.1	671.6	696.3	721.3	746.4	772.2	798.1	824.3
	Cubic Feet	9605	9746	9889	10033	10172	10306	10441	10573	10705	10834	10963	11084	11212	11341	11466
	Revolutions	290	295	299	303	307	312	316	320	323	327	330	334	337	341	344
36	Horse Power	577.7	604.1	631.0	658.2	685.8	713.8	742.2	770.9	799.4	828.8	858.6	888.8	919.2	950.0	981.2
	Cubic Feet	11444	11611	11781	11964	12118	12277	12439	12596	12742	12896	13050	13186	13346	13499	13648
	Revolutions	265	269	273	277	281	285	289	292	296	300	304	308	312	315	319

IF TURBINES TABLED DO NOT MEET CONDITIONS, OUR SPECIAL PATTERNS WILL

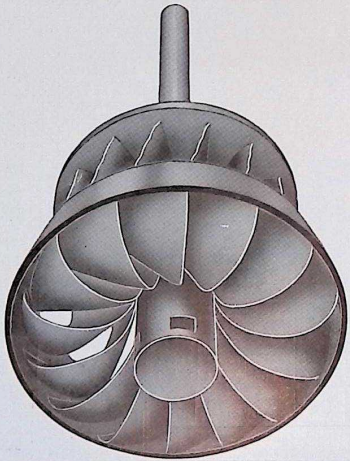
WILL FURNISH DATA ON INCREASED CAPACITY TURBINES ON APPLICATION

Diameter of Wheel in Inches	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET. 33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
39	Horse Power	677.3	708.3	739.8	771.8	804.1	836.9	870.2	903.9	937.2	971.7	1006.6	1042.4	1077.7	1113.8	1150.3
	Cubic Feet	13417	13613	13812	14016	14208	14395	14584	14770	14939	15118	15300	15478	15648	15827	16000
	Revolutions	245	249	252	256	259	263	267	270	273	277	280	283	287	290	293
42	Horse Power	785.4	821.4	857.9	894.9	932.5	970.5	1009.1	1048.2	1087.5	1127.5	1168.0	1208.8	1250.5	1292.4	
	Cubic Feet	15559	15787	16017	16251	16477	16693	16913	17128	17334	17544	17753	17949	18157	18365	
	Revolutions	227	230	234	237	240	244	247	250	253	256	259	262	265	268	
45	Horse Power	901.0	942.2	984.1	1026.6	1069.7	1113.3	1157.5	1202.4	1247.7	1293.6	1340.1	1386.4	1434.9		
	Cubic Feet	17849	18110	18373	18643	18902	19149	19400	19647	19888	20128	20369	20588	20834		
	Revolutions	212	215	219	222	225	228	231	234	237	240	243	246	249		
48	Horse Power	1016.5	1063.1	1110.3	1158.3	1206.8	1256.1	1306.0	1356.4	1407.1	1458.9	1511.3	1564.8			
	Cubic Feet	20137	20433	20729	21034	21324	21605	21888	22,53	22429	22700	22971	23237			
	Revolutions	199	202	205	208	211	214	217	219	222	225	228	231			
51	Horse Power	1158.6	1211.6	1265.5	1320.1	1375.5	1431.6	1488.5	1546.1	1603.9	1662.9	1722.7				
	Cubic Feet	22952	23287	23627	23973	24305	24623	24964	25289	25565	25874	26185				
	Revolutions	188	190	192	195	198	201	203	206	209	211	214				
54	Horse Power	1298.5	1358.0	1418.3	1479.6	1541.6	1604.5	1668.3	1732.9	1798.1	1864.3					
	Cubic Feet	25723	26100	26480	26869	27240	27597	27936	28315	28661	29008					
	Revolutions	177	180	182	185	187	190	192	195	197	199					
57	Horse Power	1446.9	1513.2	1580.4	1648.6	1717.8	1787.9	1858.9	1930.9	2003.2						
	Cubic Feet	28663	29084	29506	29938	30353	30753	31155	31550	31931						
	Revolutions	168	170	173	175	178	180	182	185	187						

In comparing the Smith with other turbines, bear in mind that these tables have been computed from tests of these turbines under the dynamometer at the Holyoke Testing Flume, and show actual performance when at work. Each size up to and including the 51" has been tested by the Holyoke Water Power Company, consequently the tables are authentic.

We do not care to compete with builders who have not had their turbines tested by the Holyoke Water Power Company, or those who have had only two or three sizes tested and guarantee other sizes to give equally as good results. The records of tests of Smith turbines are on file in our office and are open for inspection. **For your protection do not purchase a turbine that has not been tested by recognized authorities.**

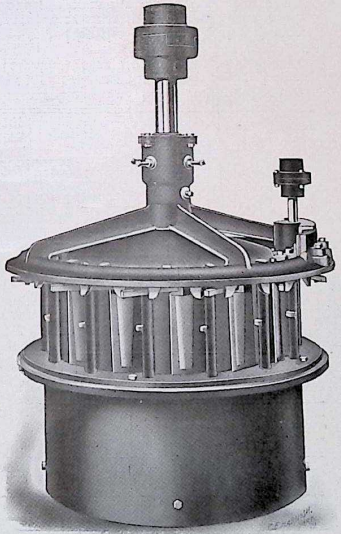
The New Success Turbine



Engraving No. 315

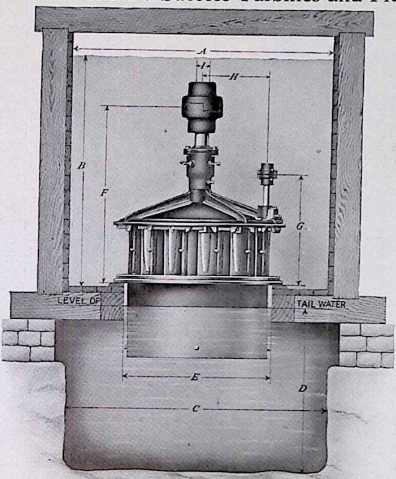
The Success are the only turbines on the market the gates of which are provided with **Independent Gate Operating Mechanism,** which makes it possible to close all the gates that are not obstructed by sticks or other foreign substance. This is accomplished by turning the hand wheel attached to the gate shaft. **Either or all the gates can be removed without disturbing any other part of the turbine.**

That part of the gate against which the gate (shifting) ring comes in contact in opening and closing, is a metal which will not break.



Engraving No. 316

Dimensions of New Success Turbines and Flumes



ENGRAVING NO. 317

DIMENSIONS IN INCHES

Diameter of Wheel	A	B	C	D	E	F	G	H	I	Extreme Diameter Casting
9	36	30	Should not be less than width of Flume indicated by letter A	24	16	24	13	$7\frac{9}{16}$	$1\frac{5}{8}$	$22\frac{3}{4}$
12	42	36		28	19	27	14	$9\frac{1}{16}$	$1\frac{7}{8}$	$25\frac{3}{4}$
15	48	42		34	22	30	$15\frac{3}{4}$	11	$1\frac{7}{8}$	$29\frac{3}{4}$
18	54	44		40	27	32	18	$12\frac{7}{8}$	$2\frac{1}{8}$	$33\frac{1}{2}$
21	60	48		45	32	36	$21\frac{1}{2}$	$14\frac{1}{16}$	$2\frac{7}{8}$	$39\frac{1}{2}$
24	66	50		51	$34\frac{1}{2}$	40	$24\frac{1}{2}$	$17\frac{9}{16}$	$3\frac{1}{8}$	$43\frac{3}{4}$
27	72	58		56	39	46	26	$18\frac{3}{8}$	$3\frac{3}{8}$	48
30	84	60		62	44	48	31	$20\frac{5}{8}$	$3\frac{5}{8}$	51
33	90	66		66	45	50	31	$22\frac{1}{16}$	$3\frac{7}{8}$	$55\frac{1}{8}$
36	96	68		72	51	54	$32\frac{7}{8}$	$24\frac{1}{16}$	$4\frac{3}{8}$	$60\frac{3}{8}$
39	108	70		78	53	58	32	$26\frac{1}{16}$	$4\frac{3}{8}$	63
42	114	74		81	59	60	36	$29\frac{5}{8}$	$4\frac{7}{8}$	72
45	126	80		84	63	66	40	$30\frac{5}{8}$	$5\frac{3}{8}$	$74\frac{1}{2}$
48	132	84		90	64	70	42	$31\frac{3}{4}$	$5\frac{3}{8}$	$77\frac{1}{2}$
51	138	86		99	70	78	44	$34\frac{3}{4}$	$5\frac{7}{8}$	76
54	144	90		105	72	80	46	$35\frac{5}{8}$	$5\frac{7}{8}$	$85\frac{1}{2}$
57	150	92		111	83	82	49	$38\frac{1}{4}$	$6\frac{3}{8}$	93
60	150	96		117	84	84	54	$39\frac{1}{4}$	$6\frac{3}{8}$	92
66	162	100		123	94	90	58	$42\frac{13}{16}$	$6\frac{7}{8}$	$99\frac{1}{4}$
72	174	106		129			60	$47\frac{1}{4}$	$6\frac{7}{8}$	$111\frac{3}{4}$

Upper half couplings can be bored to suit any size shaft. If size is not given, bore will be made in accordance with the above table. Will furnish either clutch or flange coupling as customer prefers.

Diameter of Wheel in Inches.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.															
		4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
9	Horse Power	1.0	1.4	1.9	2.5	3.0	3.5	4.2	4.8	5.5	6.3	6.9	7.7	8.5	9.4	10.1	11.0	11.9
	Cubic Feet	171	197	216	233	250	264	279	292	306	319	330	342	354	364	375	385	395
	Revolutions	292	326	357	386	412	437	462	480	506	526	546	565	584	601	619	636	653
12	Horse Power	1.8	2.6	3.3	4.2	5.2	6.3	7.3	8.5	9.7	10.8	12.2	13.4	14.9	16.2	17.7	19.3	20.8
	Cubic Feet	307	344	377	407	435	461	486	511	533	555	576	596	615	635	653	678	688
	Revolutions	218	245	268	289	310	328	346	363	379	394	410	424	437	452	464	477	489
15	Horse Power	2.9	4.1	5.4	6.8	8.4	9.9	11.7	13.5	15.4	17.3	19.4	21.5	23.7	25.9	29.0	30.7	33.1
	Cubic Feet	491	549	601	649	694	737	776	814	850	885	918	951	982	1012	1041	1070	1098
	Revolutions	175	195	214	232	247	262	277	290	303	315	327	338	350	360	371	381	391
18	Horse Power	4.3	6.1	7.9	10.0	12.3	14.6	17.1	19.7	22.6	25.4	28.4	31.5	34.7	38.7	41.5	45.0	48.5
	Cubic Feet	718	803	880	950	1016	1077	1136	1192	1244	1295	1344	1391	1437	1482	1524	1566	1607
	Revolutions	141	158	173	187	200	212	223	234	245	255	265	273	282	291	300	308	316
21	Horse Power	6.1	8.6	11.2	14.2	17.3	20.7	24.2	28.0	31.9	35.9	40.2	44.6	49.1	53.8	58.6	63.6	68.6
	Cubic Feet	1016	1136	1244	1344	1437	1524	1607	1685	1760	1832	1901	1968	2033	2095	2156	2215	2272
	Revolutions	134	150	165	178	190	202	213	223	233	243	251	260	269	278	286	293	301
24	Horse Power	8.1	11.3	14.9	18.8	22.9	27.3	32.1	36.9	42.1	47.5	53.1	58.8	64.8	71.1	77.4	84.0	90.6
	Cubic Feet	1342	1500	1644	1776	1898	2013	2122	2226	2325	2420	2511	2599	2684	2767	2847	2925	3002
	Revolutions	111	124	136	147	157	167	176	184	192	200	207	215	222	228	235	242	248
27	Horse Power	10.2	14.3	18.9	23.7	29.1	34.7	40.6	46.8	53.3	60.2	67.3	74.5	82.1	90.0	98.0	106.4	114.8
	Cubic Feet	1699	1902	2082	2249	2404	2550	2687	2818	2944	3065	3180	3292	3399	3504	3606	3705	3801
	Revolutions	103	116	127	137	147	156	163	172	180	187	194	201	207	214	220	226	232
30	Horse Power	12.3	17.2	22.6	28.6	35.0	41.8	48.8	56.4	64.3	72.5	81.0	89.9	99.0	108.4	118.1	128.1	138.4
	Cubic Feet	2048	2190	2508	2709	2878	3071	3237	3395	3547	3691	3831	3965	4096	4222	4344	4463	4579
	Revolutions	91	102	112	121	129	137	145	151	158	165	171	177	183	189	194	200	204
33	Horse Power	15.1	21.1	27.9	35.2	43.0	51.2	60.0	69.2	78.9	89.0	99.4	110.3	121.5	133.1	144.9	157.2	168.9
	Cubic Feet	2512	2809	3077	3324	3553	3769	3972	4167	4352	4530	4701	4866	5025	5180	5330	5477	5619
	Revolutions	79	89	97	105	112	119	125	132	137	144	148	154	159	163	169	173	178
36	Horse Power	17.3	24.3	31.9	40.2	49.1	58.6	68.7	79.2	90.3	101.8	113.8	126.2	139.0	152.3	165.9	179.9	194.3
	Cubic Feet	2876	3216	3523	3805	4068	4315	4548	4770	4982	5186	5381	5570	5752	5930	6102	6270	6433
	Revolutions	78	86	95	103	110	116	123	129	135	140	146	150	156	160	165	169	173

TURBINES GIVING SAME POWER AND SPEED, BUT FITTED WITH CYLINDER GATES CAN BE SUPPLIED

Diameter of Wheel in inches.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET. 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
39	Horse Power	20.4	28.5	37.5	47.3	57.8	68.9	80.8	93.2	106.2	119.7	133.8	148.4	163.5	179.0	195.0	211.5	228.5
	Cubic Feet	3381	3781	4141	4473	4782	5072	5346	5607	5856	6096	6326	6548	6762	7071	7173	7370	7561
	Revolutions	67	75	83	90	95	102	107	113	117	122	127	130	134	137	144	148	151
42	Horse Power	25.0	35.1	46.0	58.1	71.0	84.6	99.2	114.4	130.3	147.0	164.3	182.2	200.7	219.8	239.5	259.7	280.6
	Cubic Feet	4152	4642	5084	5492	5871	6228	6564	6885	7191	7475	7767	8040	8304	8559	8807	9049	9283
	Revolutions	66	73	81	88	93	99	104	110	114	118	123	127	132	136	140	144	147
45	Horse Power	26.7	37.3	49.0	61.8	75.5	90.2	105.6	121.7	138.8	156.5	174.9	194.0	213.7	234.1	255.1	276.6	298.7
	Cubic Feet	4421	4943	5624	5849	6252	6631	6990	7331	7657	7970	8271	8561	8842	9114	9378	9635	9886
	Revolutions	59	67	73	79	84	90	95	100	104	108	112	116	119	124	127	130	134
48	Horse Power	30.1	42.0	55.3	69.8	85.2	101.7	119.2	137.4	156.6	176.6	197.3	218.9	241.1	264.2	287.7	312.2	337.4
	Cubic Feet	4987	5576	6109	6597	7077	7481	7886	8271	8638	8991	9331	9659	9975	10282	10580	10870	11153
	Revolutions	57	64	70	76	81	86	91	95	99	103	107	111	114	118	121	124	128
51	Horse Power	34.3	48.0	63.0	79.4	97.0	115.8	135.7	156.5	178.3	201.0	224.7	249.2	274.6	300.7	327.6	355.3	383.7
	Cubic Feet	5678	6348	6954	7512	8030	8508	8979	9416	9835	10237	10623	10996	11357	11706	12046	12376	12698
	Revolutions	54	61	67	72	77	82	86	90	94	99	102	105	108	113	116	118	122
54	Horse Power	40.4	56.4	74.2	93.6	114.2	136.3	159.7	184.3	210.0	236.6	264.6	293.5	323.3	354.0	385.7	418.3	451.8
	Cubic Feet	6686	7475	8195	8845	9455	10029	10572	11088	11580	12054	12509	12937	13372	13783	14183	14572	14950
	Revolutions	50	56	61	66	70	74	79	83	86	90	93	96	100	103	106	108	112
57	Horse Power	45.3	63.3	83.3	104.9	128.2	153.0	178.2	206.8	235.6	265.6	291.0	320.4	362.7	397.3	432.7	469.3	506.9
	Cubic Feet	7511	8386	9187	9924	10608	11252	11861	12440	13253	13523	14033	14526	15022	15464	15913	16349	16774
	Revolutions	48	55	60	64	69	73	77	81	84	88	91	94	97	101	103	106	110
60	Horse Power	58.7	82.2	108.0	136.0	165.8	198.3	232.3	267.9	305.4	344.2	384.8	426.8	470.1	514.9	561.0	608.4	657.1
	Cubic Feet	9723	10870	11908	12862	13740	14584	15374	16124	16842	17529	18210	18829	19447	20044	20625	21192	21741
	Revolutions	45	50	55	59	63	68	71	74	78	81	84	86	90	93	95	97	101
66	Horse Power	71.1	99.3	130.6	164.6	201.1	240.0	281.0	324.2	369.4	416.6	465.6	516.3	568.9	623.0	678.8	736.2	795.1
	Cubic Feet	11765	13154	14409	15564	16669	17648	18602	19510	20378	21210	22011	22783	23530	24255	24957	25641	26308
	Revolutions	40	46	50	53	58	61	64	68	71	73	77	79	82	84	86	89	91
72	Horse Power	89.3	113.5	164.2	205.3	252.9	301.7	354.6	407.9	464.6	524.2	586.4	649.6	716.0	784.0	854.2	926.3	1000.7
	Cubic Feet	14796	16546	18119	19580	20931	22194	23412	24542	25627	26690	27687	28662	29614	30522	31408	32272	33114
	Revolutions	37	41	48	49	52	56	59	61	64	67	70	72	74	77	79	81	83

Turbines of same power but of slower speed can be built to accommodate customers

Diameter of Wheel in inches.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.																
		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
9	Horse Power	12.9	13.7	14.7	15.7	16.6	17.7	18.7	19.7	20.8	21.9	23.0	24.1	25.3	26.4	27.6	28.9	30.0
	Cubic Feet	405	415	423	433	442	451	459	467	476	484	492	500	508	516	522	530	537
	Revolutions	668	685	700	715	730	744	759	772	786	799	812	826	839	851	863	875	887
12	Horse Power	22.4	23.0	25.7	27.3	29.1	30.8	32.6	34.5	36.3	38.2	40.1	42.0	44.1	46.1	48.2	50.2	52.3
	Cubic Feet	706	722	739	754	770	785	800	814	829	843	857	871	884	898	911	924	937
	Revolutions	501	513	524	536	547	558	568	579	589	599	609	619	629	639	647	656	666
15	Horse Power	35.6	38.3	40.9	43.6	46.3	49.1	52.0	54.9	58.0	61.0	64.0	67.2	70.3	73.6	76.8	80.1	83.5
	Cubic Feet	1125	1152	1177	1202	1228	1252	1276	1299	1323	1345	1367	1389	1411	1431	1453	1473	1493
	Revolutions	401	411	420	429	437	446	455	463	471	479	487	496	503	510	518	525	532
18	Horse Power	52.2	56.0	59.9	63.8	67.9	71.9	76.1	80.4	84.7	89.2	93.7	98.2	102.9	107.6	112.4	117.2	122.2
	Cubic Feet	1647	1685	1723	1760	1796	1832	1867	1901	1935	1968	2001	2033	2064	2095	2133	2156	2186
	Revolutions	324	332	339	346	354	360	367	374	380	387	393	400	407	412	419	424	430
21	Horse Power	73.9	79.2	84.6	90.3	96.0	101.8	107.7	113.7	118.8	126.1	132.5	139.0	145.5	152.2	158.9	165.8	172.8
	Cubic Feet	2328	2383	2437	2489	2541	2591	2640	2688	2736	2783	2829	2875	2919	2963	3007	3049	3091
	Revolutions	309	315	323	330	336	343	349	356	363	369	375	381	387	392	398	404	410
24	Horse Power	97.5	104.6	111.8	119.2	126.7	134.4	142.2	150.2	158.4	166.6	175.0	183.6	192.2	201.0	210.0	219.0	228.2
	Cubic Feet	3075	3148	3218	3288	3356	3422	3487	3551	3614	3676	3737	3796	3855	3913	3971	4027	4082
	Revolutions	255	260	266	272	278	283	289	293	299	304	309	314	319	324	328	333	337
27	Horse Power	123.5	132.6	141.7	151.0	160.5	170.3	180.2	190.3	200.5	211.0	222.7	232.5	243.4	254.5	265.9	277.4	289.0
	Cubic Feet	3895	3986	4076	4164	4250	4323	4417	4497	4577	4656	4732	4808	4882	4956	5028	5100	5171
	Revolutions	238	244	249	254	259	265	270	275	279	284	289	293	298	302	308	311	315
30	Horse Power	148.8	159.6	170.7	181.9	193.4	205.1	217.0	229.2	241.6	254.2	267.0	280.1	293.3	306.8	320.3	334.2	348.2
	Cubic Feet	4692	4803	4911	5016	5119	5221	5321	5418	5514	5608	5701	5792	5882	5970	6058	6143	6228
	Revolutions	210	214	220	224	228	233	237	242	246	250	255	259	262	267	270	275	278
33	Horse Power	182.7	195.9	209.3	223.2	237.3	251.6	266.3	281.3	296.4	312.0	327.7	343.6	359.9	376.4	393.1	410.1	427.3
	Cubic Feet	5757	5893	6026	6155	6281	6407	6529	6648	6766	6882	6995	7108	7218	7326	7433	7539	7643
	Revolutions	182	187	191	194	199	203	206	211	214	217	222	225	228	232	235	238	242
36	Horse Power	209.1	225.2	239.7	255.4	271.6	288.1	304.9	322.0	339.4	357.1	375.0	393.4	412.0	438.0	450.0	469.4	489.1
	Cubic Feet	6591	6746	6898	7047	7191	7324	7473	7601	7745	7878	8008	8136	8262	8386	8509	8629	8749
	Revolutions	178	182	187	191	194	199	202	205	210	213	216	220	224	227	231	234	237

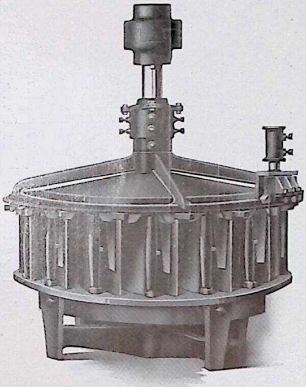
Turbines of same power and higher speed can be secured from us

Diameter of Wheel in inches	Horse Power, Cubic Feet Discharged Revolutions per Minute	HEAD IN FEET																
		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
39	Horse Power	245.8	263.6	281.7	300.4	319.3	338.7	358.4	378.4	398.9	419.8	440.9	462.4	484.3	506.5	529.0	551.8	575.0
	Cubic Feet	7748	7930	8108	8282	8453	8621	8785	8946	9106	9286	9413	9564	9712	9859	10002	10145	10284
	Revolutions	156	159	162	166	170	173	177	180	182	185	189	192	195	198	201	204	206
42	Horse Power	301.8	323.6	345.9	368.7	392.0	415.8	440.0	464.7	489.8	515.4	541.4	567.8	594.7	621.8	649.5	667.5	705.9
	Cubic Feet	9513	9736	9956	10170	10379	10585	10787	10985	11179	11370	11558	11743	11925	12104	12281	12455	12627
	Revolutions	151	155	158	161	165	168	171	174	178	181	183	187	190	192	195	198	201
45	Horse Power	321.4	344.6	368.4	392.7	417.4	442.8	468.6	494.8	521.6	548.8	576.5	604.6	633.2	662.2	691.6	721.4	751.9
	Cubic Feet	10129	10368	10601	10828	11053	11271	11486	11697	11903	12107	12308	12505	12698	12889	13077	13263	13446
	Revolutions	137	140	144	147	150	152	156	159	161	165	167	170	172	176	178	180	182
48	Horse Power	362.7	388.8	415.6	443.0	471.0												
	Cubic Feet	11428	11697	11960	12217	12470												
	Revolutions	131	134	137	141	143												
51	Horse Power	412.9	442.7	473.2	504.4	536.3												
	Cubic Feet	13011	13318	13616	13609	14186												
	Revolutions	125	128	130	134	136												

It will be noted that we have not tabled the larger size New Success Turbines at heads higher than twenty feet. While we have not tabled these turbines at the higher heads, still it is possible to use them, and we would request that if interested parties do not find a turbine tabled which exactly meets their requirements, that they advise us of all the conditions. This will enable us to select a turbine which will give the best speed and efficiency.

We build reduced capacity turbines of special design to meet requirements.

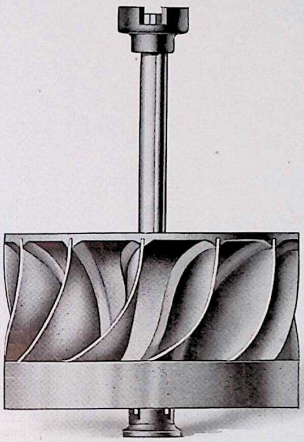
Improved Success Turbines Nos. 1 and 2



Engraving No. 318

Represents a Standard Improved Success Turbine. It is fitted with wicket gates only and, like the New Success, is provided with the independent gate operating mechanism which makes it possible to close all the gates but those in which there may be sticks or some other obstruction. This is an excellent arrangement. The dimensions for building flumes for these turbines will be furnished upon application.

Runner of Improved Success Turbine



Engraving No. 319

In addition to the Smith and New Success, we continue to build the Improved Success, which is of small power and moderate speed. These turbines are frequently used to replace old style turbines of slow speed and small power which no longer answer the requirements. They can be varied in speed somewhat and by their adoption it is often possible to continue using gears and pulleys already in place.

They are especially suited for VERY LOW heads, and having short draft tubes can be used where pits under flumes are not deep enough to admit of the use of turbines having long draft tubes. The No. 2 runs at the same speed and gives one-half more power than the No. 1 of same size. The above engraving shows the runner and shaft. Engraving No. 318 on the preceding page shows a complete turbine.

Diameter of Turbine in inches.	Number of Turbine.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET.																
			4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
10	1	Horse Power			.7	1.0	1.2	1.5	1.8	2.0	2.2	2.5	2.9	3.2	3.5	3.8	4.2	4.5	4.9
		Cubic Feet			90	97	104	110	116	122	127	132	137	142	147	151	156	160	164
		Revolutions			315	340	363	386	407	427	446	464	482	499	515	531	546	561	576
	2	Horse Power			1.2	1.5	1.9	2.2	2.6	3.0	3.4	3.8	4.3	4.8	5.3	5.8	6.3	6.8	7.3
		Cubic Feet			135	146	156	165	174	183	191	198	206	213	220	227	234	240	246
		Revolutions			315	340	363	386	407	427	446	464	482	499	515	531	546	561	576
$11\frac{1}{2}$	1	Horse Power			1.1	1.2	1.7	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.9	5.2	5.9	6.4	6.9
		Cubic Feet			126	137	146	155	163	171	179	186	193	200	207	213	219	225	231
		Revolutions			273	296	316	335	354	372	388	404	419	434	448	462	475	489	501
	2	Horse Power			1.6	2.1	2.6	3.1	3.6	4.2	4.8	5.4	6.0	6.8	7.5	8.1	8.8	9.6	10.4
		Cubic Feet			190	205	219	232	245	257	269	280	290	300	311	320	329	338	347
		Revolutions			273	296	316	335	354	372	388	404	419	434	448	462	475	489	501
13	1	Horse Power	.8	1.1	1.4	1.8	2.2	2.7	2.9	3.6	4.1	4.7	5.2	5.8	6.4	7.0	7.6	8.3	8.9
		Cubic Feet	133	149	163	176	189	200	211	221	231	241	250	258	267	275	283	291	299
		Revolutions	198	221	242	262	280	298	313	329	347	358	371	384	397	406	421	432	444
	2	Horse Power	1.2	1.6	2.1	2.8	3.3	4.0	4.7	5.4	6.2	7.0	7.9	8.7	9.6	10.5	11.5	12.4	13.5
		Cubic Feet	200	224	245	265	283	300	317	332	347	361	375	388	401	413	425	437	448
		Revolutions	198	221	242	262	280	298	313	329	347	358	371	384	397	406	421	432	444
15	1	Horse Power	1.1	1.5	2.0	2.5	3.1	3.7	4.3	5.0	5.7	6.4	7.2	8.0	8.8	9.6	10.5	11.4	12.4
		Cubic Feet	183	205	224	243	259	275	290	304	318	331	343	355	367	378	389	400	411
		Revolutions	173	191	211	227	243	257	272	285	298	309	321	333	344	355	366	375	386
	2	Horse Power	1.6	2.2	3.2	3.7	4.6	5.5	6.4	7.5	8.5	9.6	10.8	12.0	13.2	14.4	15.5	17.0	18.4
		Cubic Feet	273	306	335	362	387	410	433	454	474	494	512	530	548	564	581	597	612
		Revolutions	173	191	211	227	243	257	272	285	298	309	321	333	344	355	366	375	386
18	1	Horse Power	1.5	2.2	2.9	3.6	4.5	5.3	6.2	7.2	8.2	9.2	10.4	11.5	12.5	13.9	15.2	16.4	17.7
		Cubic Feet	263	295	323	341	373	395	417	437	458	475	493	511	528	544	560	575	590
		Revolutions	143	160	176	190	203	215	227	237	248	258	268	277	286	295	304	312	320
	2	Horse Power	2.3	3.2	4.3	5.4	6.9	7.9	9.3	10.8	12.3	13.9	15.5	17.2	19.0	20.8	22.7	24.6	26.8
		Cubic Feet	391	440	482	521	557	591	623	653	682	710	737	763	788	813	836	859	882
		Revolutions	143	160	176	190	203	215	227	237	248	258	268	277	286	295	304	312	320
21	1	Horse Powor	2.1	3.0	3.9	5.0	6.1	7.3	8.5	9.6	11.2	12.7	14.2	15.7	17.3	19.0	20.8	22.6	24.3
		Cubic Feet	360	404	441	477	510	541	570	598	624	650	675	698	721	744	765	786	807
		Revolutions	123	137	150	163	174	184	194	204	213	221	229	238	245	253	259	267	274
	2	Horse Power	3.2	4.5	6.0	7.5	9.2	10.9	12.8	14.8	16.9	19.1	21.3	23.6	26.1	28.6	31.2	33.8	36.5
		Cubic Feet	541	605	662	716	765	811	856	897	937	976	1012	1048	1082	1116	1148	1180	1210
		Revolutions	123	137	150	163	174	184	194	204	213	221	229	238	245	253	259	267	274

Tables of Improved Success Turbines Nos. 1 and 2

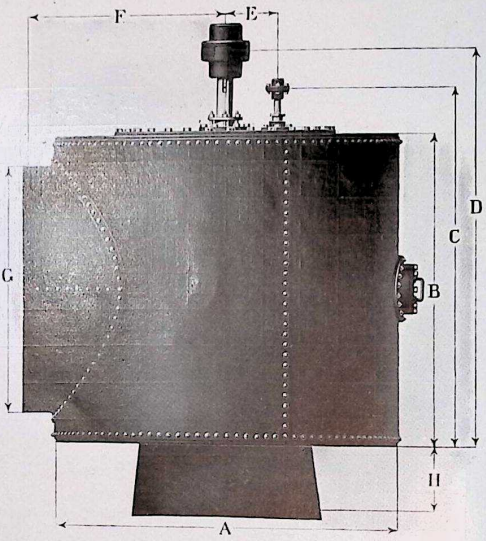
Diameter of Runner in Inches.	Number of Turbine.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET																
			4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
24	1	Horse Power	2.7	3.8	5.2	6.3	7.7	9.2	10.8	12.4	14.2	16.0	17.9	19.6	21.9	24.0	26.1	28.4	30.4
		Cubic Feet	454	507	551	601	642	681	718	753	781	819	850	879	909	937	964	990	1008
		Revolutions	108	120	132	142	152	161	170	178	186	194	201	208	215	222	228	234	240
	2	Horse Power	4.0	5.6	7.5	9.5	11.6	13.8	16.2	18.7	21.3	24.0	26.9	29.8	32.8	35.9	39.2	42.4	46.0
		Cubic Feet	681	761	834	901	963	1022	1078	1130	1180	1229	1275	1319	1363	1405	1446	1486	1524
		Revolutions	108	120	132	142	152	161	170	178	186	194	201	208	215	222	228	234	240
27	1	Horse Power	3.4	5.0	6.6	8.4	10.2	12.2	14.4	16.5	19.6	21.2	23.7	26.3	29.0	31.8	34.6	37.6	40.6
		Cubic Feet	601	672	736	795	850	901	961	997	1051	1084	1125	1164	1203	1240	1276	1311	1345
		Revolutions	97	108	116	127	135	143	151	159	166	172	179	185	191	197	203	208	214
	2	Horse Power	5.4	7.6	8.9	12.0	14.8	18.0	21.5	24.8	28.3	31.9	35.6	39.8	43.6	47.7	52.0	56.4	60.9
		Cubic Feet	901	1008	1104	1193	1275	1352	1426	1495	1561	1626	1687	1746	1814	1860	1914	1966	2018
		Revolutions	97	108	116	127	135	143	151	159	166	172	179	185	191	197	203	208	214
30	1	Horse Power	4.4	6.3	8.2	10.4	12.7	15.2	17.8	20.5	23.4	26.4	30.2	32.8	36.1	39.8	43.1	46.8	50.5
		Cubic Feet	740	836	916	990	1058	1122	1183	1240	1295	1349	1400	1449	1497	1543	1588	1631	1674
		Revolutions	86	96	105	113	122	129	136	143	148	155	161	167	172	177	182	187	192
	2	Horse Power	6.7	9.4	12.4	15.2	19.1	22.7	26.5	30.8	35.2	39.7	44.4	49.2	54.2	59.4	64.4	70.2	75.8
		Cubic Feet	1122	1254	1374	1485	1587	1683	1775	1861	1943	2025	2100	2173	2246	2315	2372	2447	2511
		Revolutions	86	96	105	113	122	129	136	143	148	155	161	167	172	177	182	187	192
33	1	Horse Power	5.4	7.6	10.0	12.5	15.3	18.3	21.6	24.8	28.2	31.9	35.6	39.5	43.6	47.7	52.0	56.4	60.9
		Cubic Feet	901	1008	1104	1193	1275	1353	1436	1495	1561	1626	1687	1746	1804	1860	1914	1966	2018
		Revolutions	79	88	100	109	112	118	125	130	136	143	148	153	157	163	167	172	176
	2	Horse Power	8.0	11.3	14.9	18.8	23.0	27.5	32.1	37.2	42.3	47.7	53.3	59.4	65.2	71.4	77.6	84.4	91.2
		Cubic Feet	1349	1508	1652	1785	1908	2024	2135	2238	2337	2434	2525	2613	2700	2783	2864	2943	3019
		Revolutions	79	88	100	109	112	118	125	130	136	143	148	153	157	163	167	172	176
36	1	Horse Power	6.3	8.8	11.6	14.6	17.9	21.3	25.0	28.8	32.8	37.1	41.4	46.0	50.7	55.5	60.4	65.6	71.3
		Cubic Feet	1048	1172	1284	1387	1483	1573	1659	1739	1816	1891	1962	2031	2099	2163	2226	2287	2347
		Revolutions	72	80	88	95	102	108	1 14	118	124	129	134	139	142	148	152	156	160
	2	Horse Power	9.4	13.2	17.3	21.9	26.8	32.0	37.5	43.2	49.2	55.6	62.0	68 8	75.9	83.1	90.6	98.2	106.1
		Cubic Feet	1569	1765	1922	2077	2220	2354	2483	2603	2718	2831	2937	3040	3141	3238	3332	3424	3513
		Revolutions	72	80	88	95	102	108	114	118	124	129	134	139	142	148	152	156	160
39	1	Horse Power	8.0	11.2	14 8	18.6	22.8	27.2	31.9	36.8	41.9	47.2	52.8	58.6	64.6	70.7	77.1	83.2	89.6
		Cubic Feet	1336	1494	1636	1768	1890	2004	2114	2216	2314	2410	2500	2588	2674	2756	2836	2914	2990
		Revolutions	67	74	82	89	95	100	106	110	115	120	124	129	132	137	141	145	148
	2	Horse Power	12 0	16.8	22.0	27.6	34.0	42.7	47.0	55.2	62.4	70.4	78.8	87.3	96.3	105.4	115.2	124.8	134.6
		Cubic Feet	1990	2226	2437	2614	2816	2985	3150	3301	3449	3590	3725	3857	3984	4106	4225	4341	4455
		Revolutions	67	74	82	89	95	100	106	110	115	120	124	129	132	137	141	145	148

Tables of Improved Success Turbines Nos. 1 and 2

Diameter of Turbine in inches.	Number of Turbine.	Horse Power, Cubic Feet, Discharged, Revolutions per Minute.	HEAD IN FEET																
			4	5	6	7	8	9	10	11	12	13	14	15	26	17	18	19	20
42	1	Horse Power	9.6	13.6	17.8	22.4	27.5	32.8	38.4	41.2	50.4	57.0	63.6	70.9	77.8	84.8	92.8	100.8	108.8
		Cubic Feet	1605	1800	1971	2130	2277	2414	2547	2770	2788	2904	3012	3118	3222	3320	3417	3571	3602
		Revolutions	62	69	75	82	87	92	97	102	106	111	115	119	123	127	130	134	137
	2	Horse Power	14.5	20.3	26.6	33.6	41.2	49.1	57.6	68.8	75.6	85.4	95.2	105.8	116.6	127.7	138.8	150.9	162.7
		Cubic Feet	2411	2696	2942	3191	3411	3617	3815	3099	4176	4350	4512	4671	4826	4974	5108	5259	5396
		Revolutions	62	69	75	82	87	92	97	102	106	111	115	119	123	127	130	134	137
48	1	Horse Power	12.6	17.6	23.2	29.2	35 8	42.7	50.0	57.7	65.8	74.2	82.4	92.0	100.8	110.4	120.8	131.2	141.6
		Cubic Feet	2097	2345	2568	2775	2967	3146	3318	3479	3632	3783	3925	4063	4198	4326	4452	4574	4694
		Revolutions	54	59	66	71	76	81	85	89	93	97	101	104	106	109	113	117	120
	2	Horse Power	18.9	26.4	34 8	43.8	53.7	64.0	75.0	86.5	98.7	111.3	123.6	138.0	150.4	165.6	181.2	196.8	212.4
		Cubic Feet	3105	3517	3852	4162	4450	4719	4977	5218	5448	5674	5887	6094	6297	6489	6678	6861	7041
		Revolutions	54	59	66	71	76	81	85	89	93	97	101	104	106	109	113	117	120
54	1	Horse Power	15.6	21.7	28.6	36.1	44.1	52.7	61.7	71.2	80.8	91.2	101.6	112.8	124.8	136.8	148.8	161.2	174.4
		Cubic Feet	2585	2890	3165	3421	3657	3877	4090	4287	4477	4663	4837	5007	5174	5332	5487	5618	5785
		Revolutions	48	54	59	64	68	72	76	80	83	86	90	93	95	97	98	101	104
	2	Horse Power	23.4	32.5	42.9	54.1	66.1	79.0	92.5	106.8	121.2	136.8	152.4	169.2	187.2	205.2	223.2	241.8	261.6
		Cubic Feet	3877	4335	4747	5131	5485	5815	6135	6430	6715	6994	7255	7510	7761	7998	8230	8427	8677
		Revolutions	48	54	59	64	68	72	76	80	83	86	90	93	95	97	98	101	104
60	1	Horse Power	19.6	27.4	36.0	45.5	55.6	66.3	77.7	89.6	101.6	115.2	128.7	142.4	156.8	172.3	187.2	203.2	220.0
		Cubic Feet	3253	3637	3983	4305	4602	4879	5147	5395	5634	5868	6087	6301	6511	6710	6905	7095	7280
		Revolutions	43	48	53	57	61	65	68	70	74	77	80	83	86	89	92	94	97
	2	Horse Power	29.4	41.1	54.1	68.2	83.4	99.4	116.6	139.4	152.4	172.8	193.0	213.6	235.2	258.4	280 8	304.8	330.0
		Cubic Feet	4357	5455	5974	6457	6903	7318	7720	8092	851	8802	9130	9451	9766	10065	10357	10642	10920
		Revolutions	43	48	53	57	61	65	68	70	74	77	80	83	86	89	92	94	97
66	1	Horse Power	24.4	34.1	44.9	56.6	69.2	82.5	96.7	111.2	126.4	143.4	160.2	177.6	195.2	214.4	233.6	258.0	273.5
		Cubic Feet	4048	4526	4957	5357	5726	6072	6405	6714	7011	7302	7575	7841	8102	8350	8593	8829	9059
		Revolutions	40	44	49	52	56	59	62	64	67	70	72	75	78	82	84	85	87
	2	Horse Power	36.6	51.2	67.4	84.9	103.8	123.8	145.0	166.8	189.6	215.1	240.3	266.4	292.8	321.6	350.4	387.1	410.2
		Cubic Feet	6072	6789	7435	8035	8589	9108	9607	10071	10516	10953	11362	11761	12153	12525	12889	13243	13584
		Revolutions	40	44	49	52	56	59	62	64	67	70	72	75	78	82	84	85	87
72	1	Horse Power	28.8	40.2	52.9	66.7	81.5	97.2	114.0	131.4	149.6	168.8	188.8	209.8	230.4	252.7	275.2	300.8	322.5
		Cubic Feet	4769	5333	5840	6311	6747	7154	7546	7911	8260	8603	8925	9239	9546	9838	10124	10402	10674
		Revolutions	36	40	44	48	50	53	56	59	62	64	66	69	72	75	77	81	84
	2	Horse Power	43.2	60.4	79.4	100.0	122 2	146 9	171.0	197.1	224.4	253.2	283.2	313.2	345.6	379.0	412.8	451.2	483.7
		Cubic Feet	7153	7999	8760	9466	10120	10731	11319	11866	12390	12904	13387	13858	14319	14759	15186	15603	16011
		Revolutions	36	40	44	48	50	53	56	59	62	64	66	69	72	75	77	81	84

Diameter of Wheel in Inches.	Number of Turbine.	Horse Power, Cubic Feet Discharged, Revolutions per Minute.	HEAD IN FEET																
			21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
10	1	Horse Power	5.2	5.6	6.0	6.4	6.8	7.2	7.7	8.1	8.6	9.1	9.5	10.0	10.5	11.0	11.4	11.9	12.4
		Cubic Feet	168	172	176	180	183	187	191	194	197	201	204	207	211	214	217	220	223
		Revolutions	590	604	617	631	644	656	669	684	693	700	717	728	740	753	762	772	782
	2	Horse Power	7.9	8.5	9.1	9.7	10.4	11.0	11.6	12.4	12.9	13.6	14.3	15.0	15.7	16.5	17.2	17.9	18.7
		Cubic Feet	252	258	264	270	275	281	286	291	296	302	306	311	316	323	326	330	335
		Revolutions	590	604	617	631	644	656	669	684	693	700	717	728	740	753	762	772	782
$11\frac{1}{2}$	1	Horse Power	7.5	8.0	8.5	8.8	9.6	10.0	10.4	11.2	12.0	12.8	13.4	13.6	14.4	15.2	16.0	16.8	17.3
		Cubic Feet	237	242	248	253	258	264	269	274	278	283	288	292	297	302	306	310	315
		Revolutions	513	526	538	549	560	571	582	592	603	613	624	634	643	653	663	672	681
	2	Horse Power	11.2	12.0	12.8	13.7	14.8	15.5	16.4	17.3	18.4	19.2	20.0	20.8	31.6	23.2	24.2	24.8	25.6
		Cubic Feet	355	364	372	380	388	396	403	411	418	425	432	439	446	453	459	466	472
		Revolutions	513	526	538	549	560	571	582	592	603	613	624	634	643	653	663	672	681
13	1	Horse Power	9.6	10.4	11.0	11.8	12.5	13.5	14.0	14.8	15.7	16.5	17.3	18.2	19.1	19.9	20.8	21.7	22.6
		Cubic Feet	306	313	320	327	334	340	347	353	359	36	372	378	384	389	395	401	406
		Revolutions	454	465	476	486	496	506	515	525	535	543	552	561	570	578	587	595	603
	2	Horse Power	14.5	15.3	16.6	17.7	18.8	20.0	21.2	22.4	23.6	24.8	26.0	27.3	28.0	30.0	31.3	32.5	34.0
		Cubic Feet	459	470	480	491	501	511	520	530	539	549	558	567	576	584	593	601	609
		Revolutions	454	465	476	486	496	506	515	525	535	543	552	561	570	578	587	595	603
15	1	Horse Power	13.2	13.7	15.2	16.3	17.2	18.3	19.4	20.5	21.6	22.8	23.9	25.0	26.3	27.4	28.7	29.9	31.2
		Cubic Feet	421	430	440	450	459	468	477	486	494	503	511	519	528	535	544	551	558
		Revolutions	394	403	412	421	429	438	446	454	462	468	478	486	493	502	507	515	522
	2	Horse Power	19.8	21.2	22.8	24.3	25.8	27.3	28.9	30.5	32.2	33.9	35.6	37.3	39.2	41.0	42.8	44.6	46.3
		Cubic Feet	627	642	656	671	685	698	711	724	737	750	762	774	787	799	810	822	833
		Revolutions	394	403	412	421	429	438	446	454	462	468	478	486	493	502	507	515	522
18	1	Horse Power	19.1	20.4	21.9	23.3	24.8	27.0	27.9	29.5	31.0	32.7	34.3	36.0	37.7	39.4	41.2	42.9	44.8
		Cubic Feet	604	618	632	646	660	673	685	698	710	722	734	746	758	769	780	791	803
		Revolutions	328	336	343	343	358	365	377	382	385	389	399	405	411	419	423	429	435
	2	Horse Power	28.6	30.6	32.8	34.9	37.0	39.4	41.7	44.0	46.4	48.8	51.3	53.8	56.4	53.9	61.3	64.2	66.9
		Cubic Feet	903	924	945	665	985	1005	1024	1043	1060	1079	1097	1115	1132	1149	1166	1182	1199
		Revolutions	328	336	343	350	358	365	377	382	385	398	399	405	411	819	423	429	435
21	1	Horse Power	26.1	28.0	29.8	32.0	34.0	36.0	38.1	40.3	42.4	44.1	46.9	49.2	51.6	52.0	56.1	58.8	61.2
		Cubic Feet	826	846	865	883	902	920	837	954	971	988	1004	1020	1036	1052	1067	1082	1097
		Revolutions	281	288	294	300	307	313	318	324	330	336	341	347	352	358	363	368	373
	2	Horse Power	39.2	42.1	44.4	48.0	51.2	54.1	57.3	60.5	63.8	67.0	70.4	74.1	77.5	81.0	86.4	88.0	91.2
		Cubic Feet	1239	1269	1297	1325	1353	1380	1406	1432	1457	1482	1506	1535	1555	1576	1601	1624	1646
		Revolutions	281	288	294	300	307	313	318	324	330	336	341	347	352	358	363	368	373

Steel Flumes for Turbines



Engraving No. 320

The cost of steel flumes usually exceeds that of those constructed of wood, but for many installations they are more desirable on account of their durability and freedom from leakage.

Each flume has a heavy cast iron top, bottom and cover plate of sufficient size to admit the turbine, and contains packing boxes for turbine and gate shafts.

A man door is conveniently located on the side of the flume affording easy access to the turbine. See dimensions of flumes on opposite page.

We make a specialty of building steel flumes to replace wooden flumes.

Dimensions of Steel Flumes

IN INCHES FOR SMITH TURBINES

Lettered columns correspond with letters in engraving on opposite page

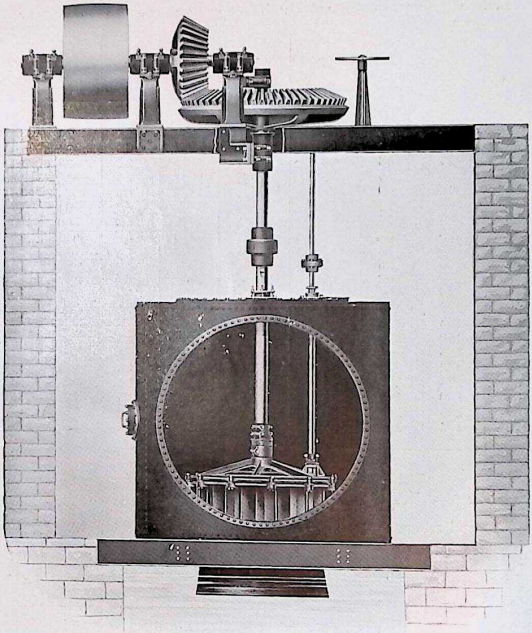
Diam. of Turbine	A	B	C	D	E	F	G	H
9								
12	36	36	53 1/4	61 1/4	7	22	24	8 3/8
15	45	42	59 1/4	67 1/4	9 1/8	28	30	10 3/4
18	54	48	65 1/4	73 1/4	10 1/16	32	36	13 1/4
21	60	54	71 1/2	79 1/2	12 1/16	34	42	15
24	72	60	75 1/2	85 1/2	14 3/8	40	48	16 1/2
27	78	72	89 1/2	97 1/2	16 1/2	42	54	17
30	84	76	93 1/2	103 1/2	18 1/2	46	60	19
33	96	82	103 3/4	113 3/4	21 1/8	52	66	21 1/4
36	102	90	111 3/4	121 3/4	23	56	75	23 1/4
39	108	96	113 3/4	125 3/4	24 3/4	58	81	25 1/4
42	120	102	123 3/4	135 3/4	26	64	87	27
45	126	102	123 3/4	135 3/4	28	70	87	30
48	138	106	127 7/8	139 7/8	29 3/4	74	90	32 7/8
51	144	110	133 7/8	145 7/8	31 3/4	78	96	34 3/4
54	150	118	143 7/8	155 7/8	33	80	102	37 1/8
57	156	118	143 7/8	155 7/8	52	82	102	39 1/8
60	162	125	150	162	54	88	108	40 1/2
63	174	130	163	175	55 1/2	92	114	42
66	180	150	175	187	57 1/4	96	132	44
69	186	156	180	194	60	100	136	45
72	192	160	186	200	63	102	141	46

Dimensions of Steel Flumes

IN INCHES FOR NEW SUCCESS TURBINES

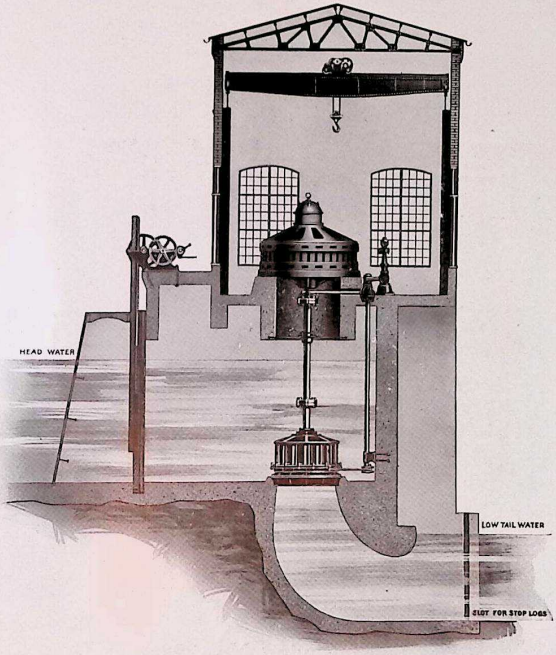
Lettered columns correspond with letters in engraving on opposite page

Dia. of Turbine	A	B	C	D	E	F	G	H
9	36	30	38 1/4	51 1/4	7 9/16	24	15	7
12	42	33	48 1/4	55 1/4	9 9/16	27	21	7 9/16
15	48	42	52 1/4	63 1/4	11 1/8	30	27	10 3/8
18	54	48	58 1/4	69 1/4	12 7/8	33	33	11
21	60	54	64 1/2	75 1/2	14 1/16	36	39	12 7/8
24	66	57	67 1/2	79 1/2	17 9/16	39	43	13 15/16
27	72	60	70 1/2	83 1/2	18 3/4	42	48	14 3/4
30	78	69	81 1/2	88 1/2	20 3/8	45	53	17 1/4
33	84	76	88 3/4	94 3/4	22 1/16	48	59	18
36	93	80	91 3/4	98 3/4	24 1/16	52	63	20 3/4
39	102	84	97 3/4	103 3/4	26 1/16	57	68	21 3/4
42	114	92	105 3/4	109 3/4	29 3/8	63	75	24 3/4
45	120	96	109 3/4	113 3/4	30 7/16	66	78	25
48	126	100	113 7/8	117 7/8	31 3/4	69	82	26 1/8
51	132	105	117 7/8	121 7/8	34 3/4	72	88	27 3/8



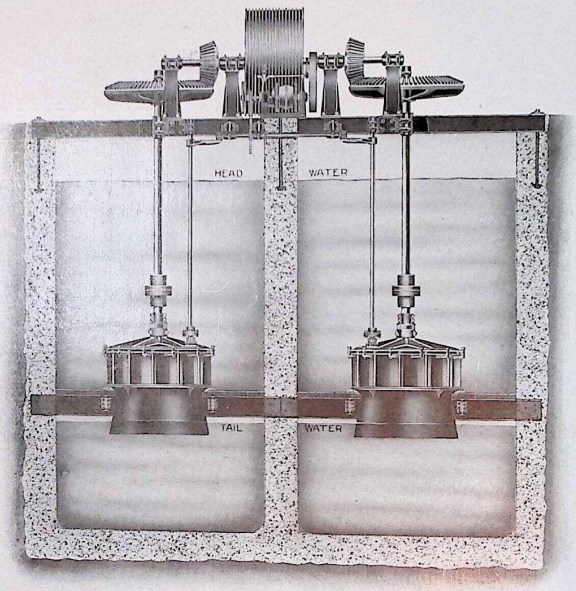
Engraving No. 321

Represents a Vertical Wicket Gate Turbine in steel flume. The design for supporting the gears, pulley, vertical and horizontal shafts is first-class in every particular. This makes a very compact and economical installation.



Engraving No. 322

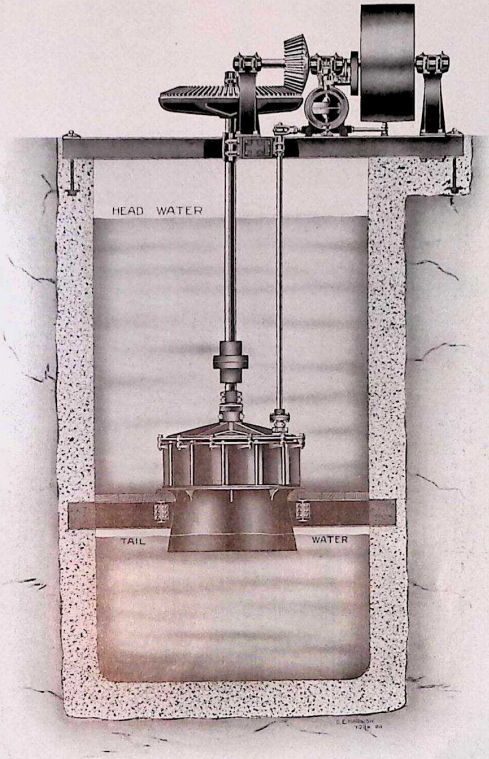
Represents a Smith Wicket Gate Turbine connected to a vertical generator and discharging into a concrete draft tube. The thrust bearing for carrying the weight and thrust of the runner also the weight of the rotor of the generator is placed on top of the generator. By removing the rotor of the generator the turbine can usually be taken out of the flume.



Engraving No. 323

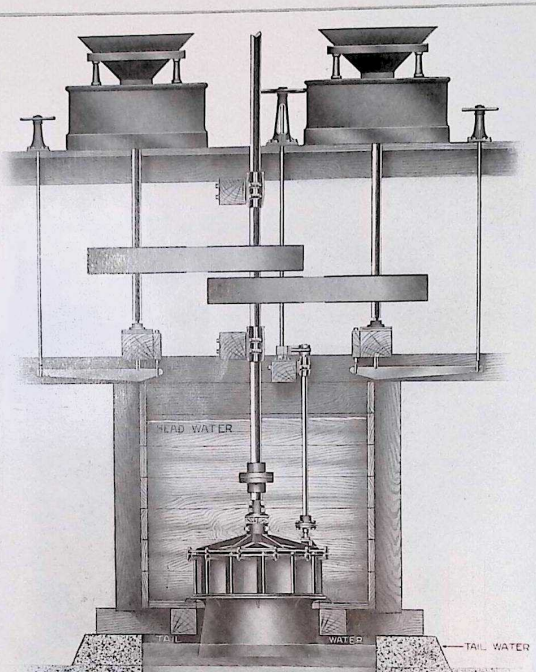
Represents two Vertical Wicket Gate Turbines in open flumes driving horizontal shaft and rope sheave through bevel mortise gears.

We have furnished turbine equipments with from one to eight turbines driving one horizontal shaft, arranged for direct connection to generators and with pulley and rope drives.



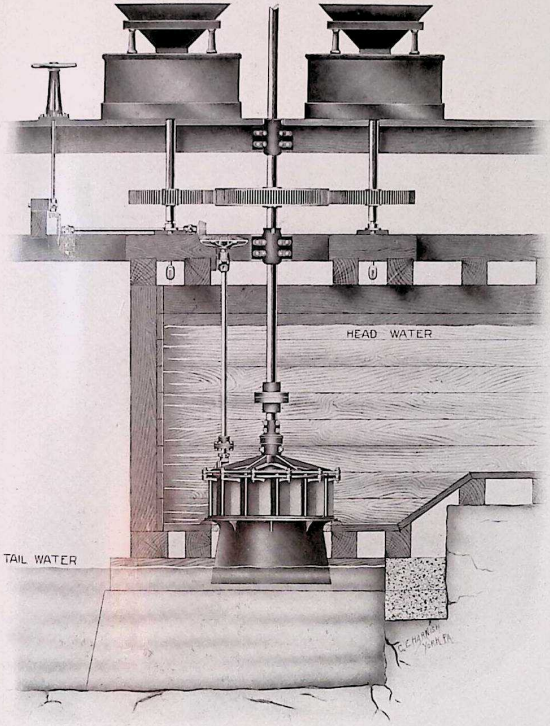
Engraving No. 324

Represents a single Vertical Wicket Gate Turbine installed in an open concrete flume with bevel mortise gears and steel harness. Also a governor and connections. We build similar outfits arranged for direct connection to generators instead of pulley drives.



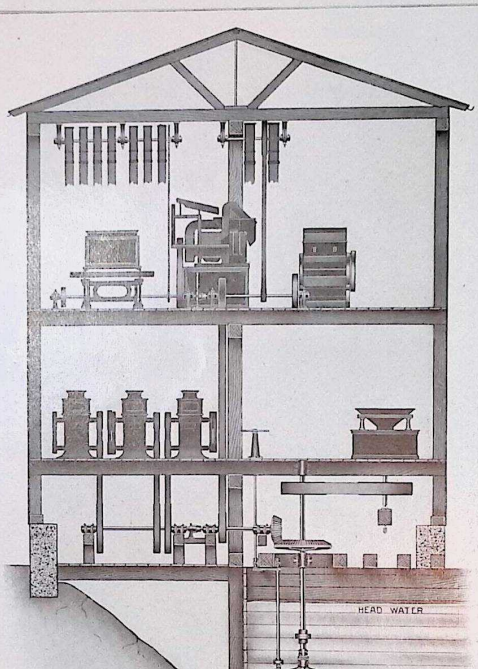
Engraving No. 325

Represents a Vertical Wicket Gate Turbine in a timber flume driving two pairs of buhrs by belts from pulleys on the turbine shaft.



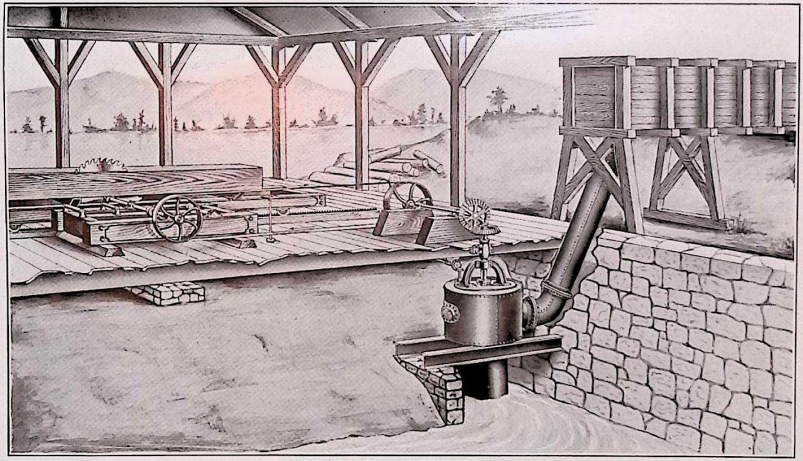
Engraving No. 326

Represents a Vertical Wicket Gate Turbine in a timber flume driving two pairs of buhrs through a spur mortise gear on the turbine shaft and spur pinions on the spindles.



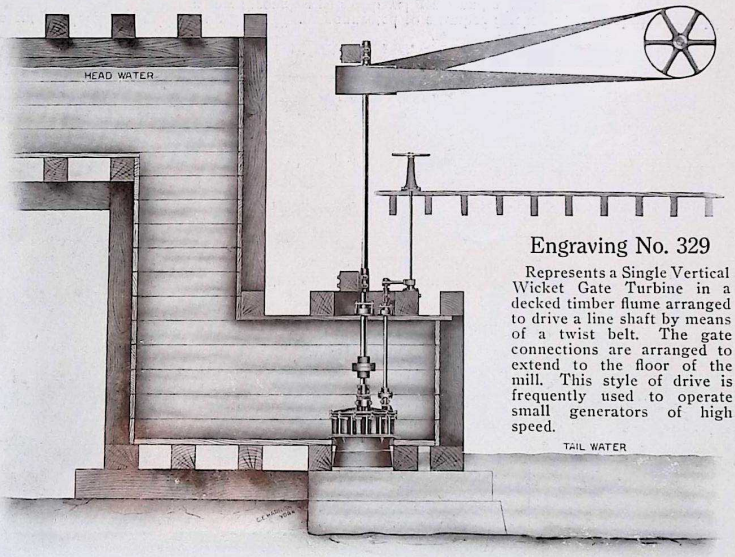
Engraving No. 327

Represents a Vertical Wicket Gate Turbine in a timber flume driving a pair of buhrs by a belt from the turbine shaft and the roller mill machinery through a pair of bevel mortise gears and pulleys on a horizontal shaft.



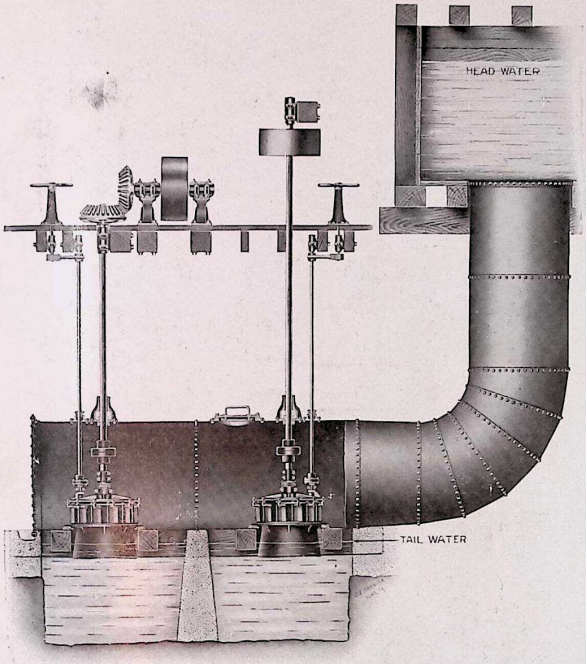
Engraving No. 328

Represents a Vertical Turbine in a Steel Flume connected to a timber forebay by a steel pipe and driving a saw through a pair of bevel gears and a belt.



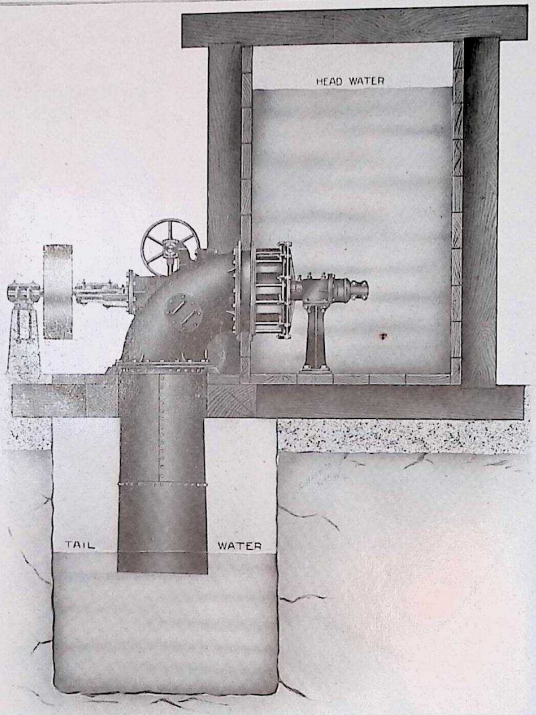
Engraving No. 329

Represents a Single Vertical Wicket Gate Turbine in a decked timber flume arranged to drive a line shaft by means of a twist belt. The gate connections are arranged to extend to the floor of the mill. This style of drive is frequently used to operate small generators of high speed.



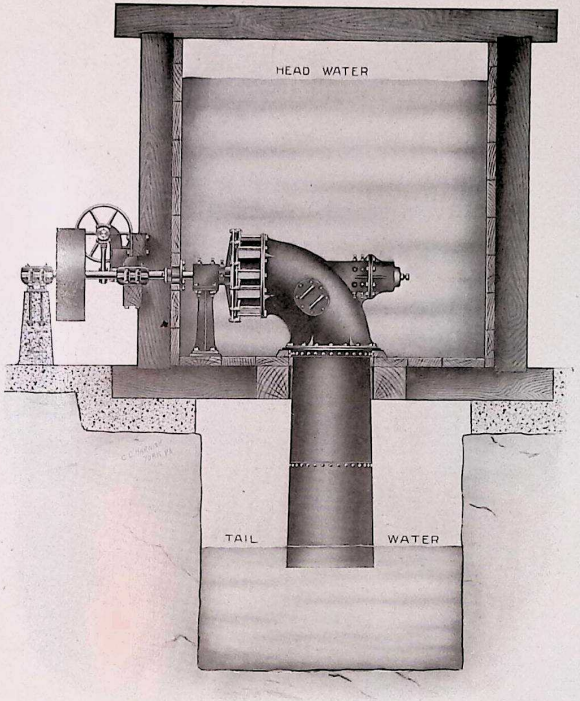
Engraving No. 330

Represents two Vertical Wicket Gate Turbines in one steel flume, being a continuation of the supply pipe. One turbine is arranged with a pulley on the vertical shaft and the other drives a horizontal shaft and pulley through bevel mortise gears.



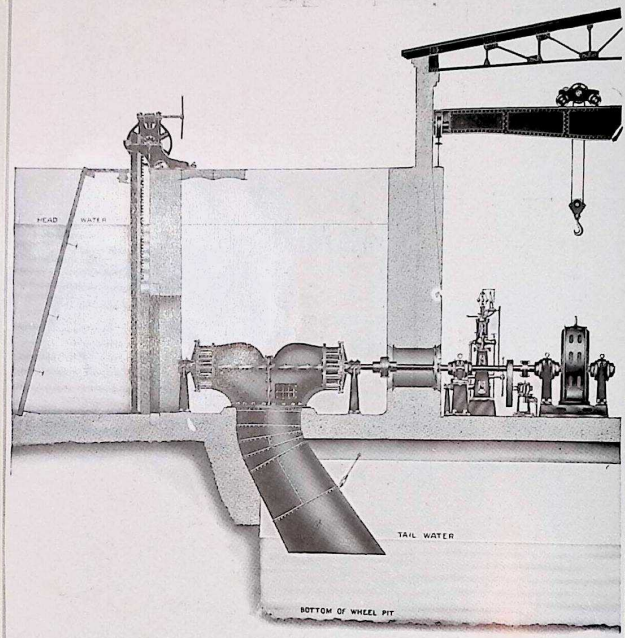
Engraving No. 331

Represents a wicket gate turbine mounted on horizontal shaft in a wooden flume open at the top. The elbow, steel draft tube and driving pulley are outside of the flume. This is a very simple and popular setting as it makes it possible to drive a generator or line shaft without gears, which are generally used if a vertical turbine is adopted. The wheel could also be mounted in a decked wooden flume if the head of water is high.



Engraving No. 332

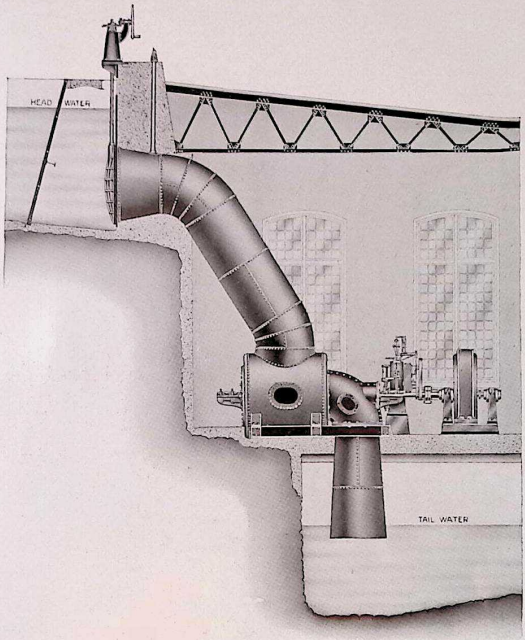
Represents a Single Horizontal Wicket Gate Turbine mounted on a cast iron quarter-turn placed in a timber flume open at the top. The shaft passes through a packing box and the pulley is on the outside of the flume. Outfits of this design can be arranged for direct connection to generators or pulp grinders when desired. Cylinder Gate Turbines can be arranged in the same manner and the gate operating mechanism placed outside of the flume.



Engraving No. 333

Pair Horizontal Wicket Gate Turbines mounted on a cast iron draft chest in an open flume, direct connected to a generator.

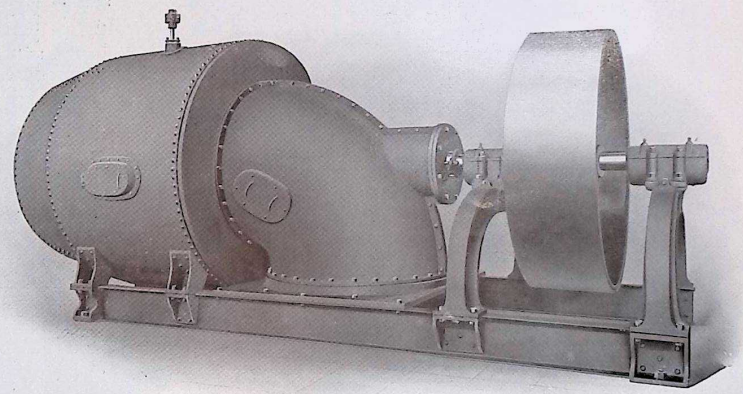
We have built thousands of turbines with both Cylinder and Wicket Gates similarly mounted which are driving generators, also machinery in pulp, paper, and textile mills.



Engraving No. 334

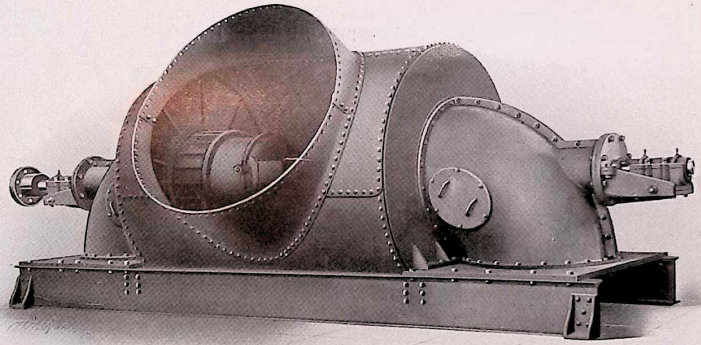
Single turbine in steel flume with quarter turn discharge, direct connected to a generator. The water enters the top of the flume through a steel pipe. An iron head gate is placed in front of the pipe. However, wooden gates are generally used.

We have built hundreds of turbines of similar design operating under many different conditions driving all kinds of machinery. We can substitute a pulley or sheave for coupling when the power is to be transmitted by belt or rope.



Engraving No. 335

Single Horizontal Turbine arranged to drive a generator by belt. The water enters through one end of the steel flume in which the turbine is mounted. We also furnish outfits built in this manner for direct connection to generators and pulp grinders by substituting a coupling for the pulley.

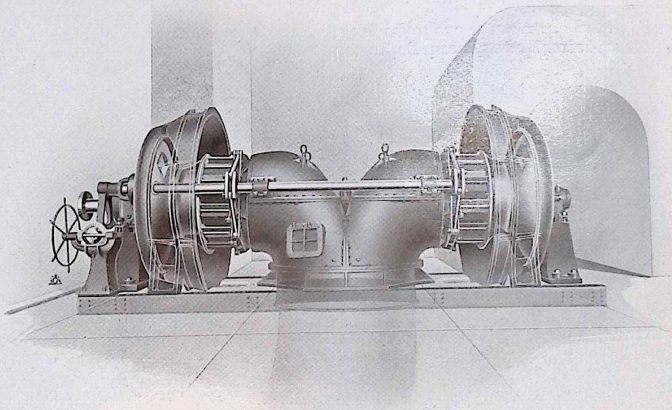


Engraving No. 336

Pair of Cylinder Gate Turbines in steel flume discharging through two quarter-turns and draft tubes.

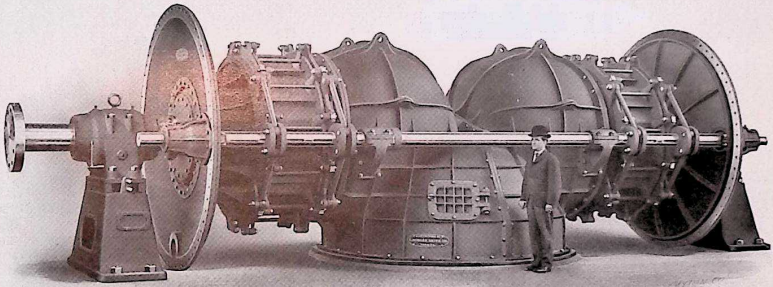
Outfits of this design can be arranged so that the gates of one of the turbines can be closed without entering the flume and only one turbine operated.

We build turbines with wicket gates similarly mounted.



Engraving No. 337

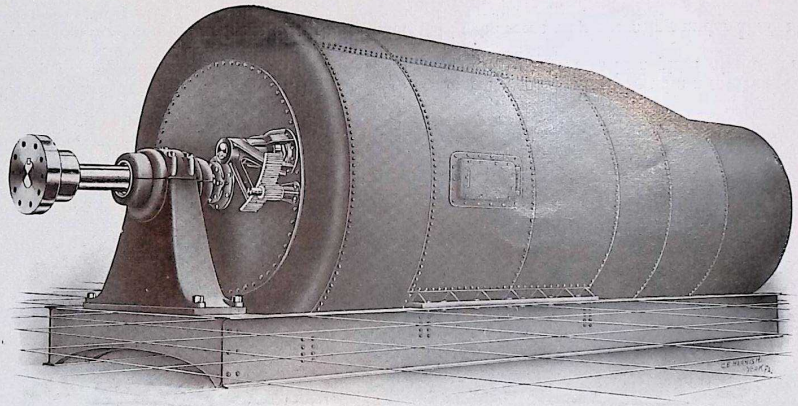
Represents one of six pairs of Horizontal Turbines each having a capacity of 1800 H. P., at 200 R. P. M., under 42 feet head and mounted on a cast iron draft chest in an open flume with cast iron wall rings at each end extending through the concrete flume walls. The end bearings are of the ring oiling babbitted type. A tunnel is provided for access to the remote turbine and bearing.



Engraving No. 338

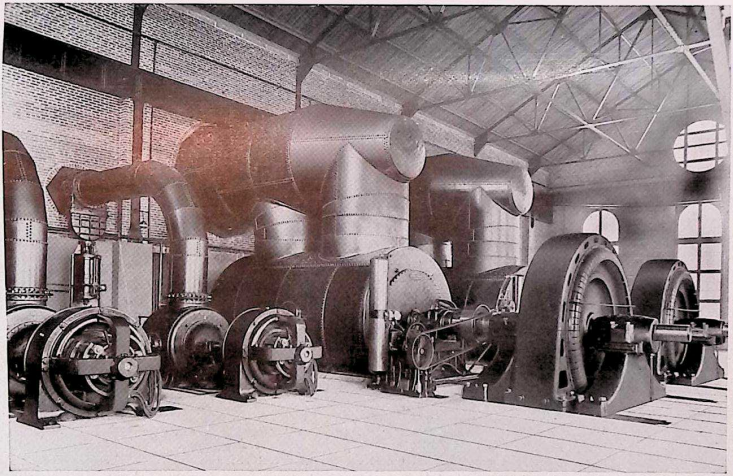
Pair Wicket Gate Turbines 5,200 H. P., 225 R. P. M., 60 feet head. Six units with a total capacity of 31,200 H. P., each mounted in a steel flume, are now operating generators in a plant of the Southern Power Co., Charlotte, N. C.

We have built many hundreds of turbines mounted in the same way operating under almost every conceivable condition.



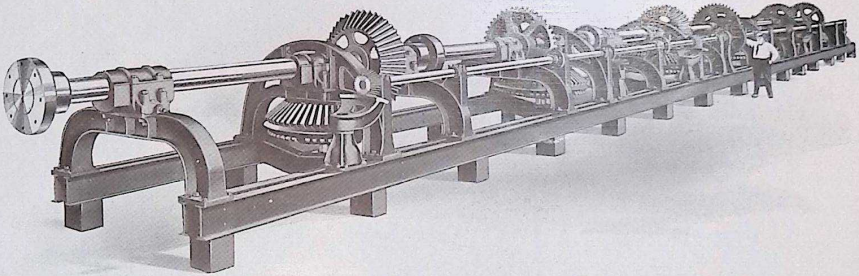
Engraving No. 339

Represents a pair of turbines mounted on a center discharge chest incased in a steel flume with water entering at the end. We have built turbines mounted in this style which are developing several hundred thousand horse-power. The International Paper Company are using eleven thousand horse-power at Livemore Falls and twelve thousand horse-power at Wilder, Vt. Outfits of this type can be arranged with the feeder on the side or top when desired.



Engraving No. 340

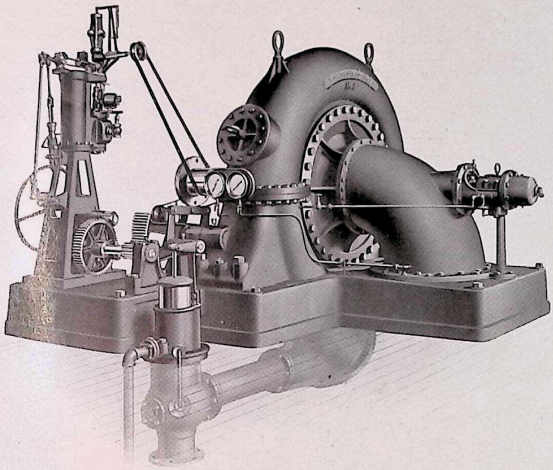
POWER PLANT OF THE LA CROSSE WATER POWER CO., LA CROSSE, WIS.
Two turbine units each of 4,000 H. P., 300 R. P. M., and two exciter units were installed in the above plant and are operating under 86 feet head.



Engraving No. 341

Represents the harness work for six 51" Vertical Smith Turbines, four units of which were furnished the Montreal Light, Heat and Power Co. We are prepared to furnish steel harness work and gears for any number of turbines.

"Francis" Turbines



Engraving No. 342

We are prepared to design and build turbines of special design for heads up to 650 feet encased in either pressure or spiral flumes. Engraving No. 342 represents a single Francis turbine in a cast iron spiral flume with governor mounted on a bed plate. The relief valve is arranged to open when the governor closes the gates of the turbines suddenly, and then automatically closes.

Power Transmission Machinery

In addition to the **Turbines**, **Gate Hoists** and **Valves** described in this bulletin, we call attention to the fact that we are prepared to furnish:

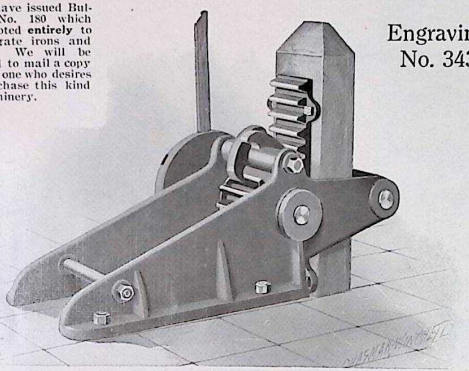
SHAFTING	TRASH RACK
GEARING	RIVETED STEEL PIPE
BEARINGS OF ALL KINDS	PULLEYS
I-BEAM FRAMES	ROPE DRIVES

Also all kinds of machinery used in connection with hydraulic installations excepting electrical machinery.

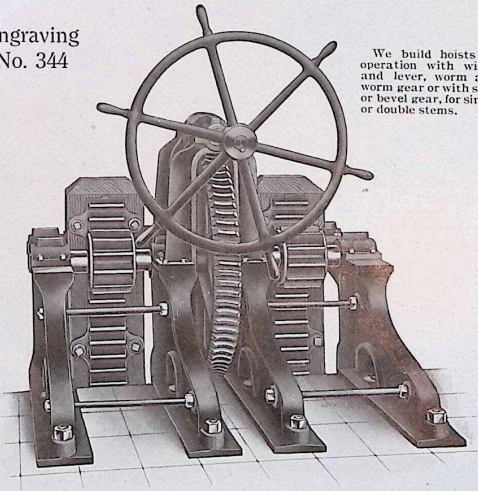
Head Gate Hoists

We have issued Bulletin No. 180 which is devoted **entirely** to head gate irons and valves. We will be pleased to mail a copy to any one who desires to purchase this kind of machinery.

Engraving No. 343

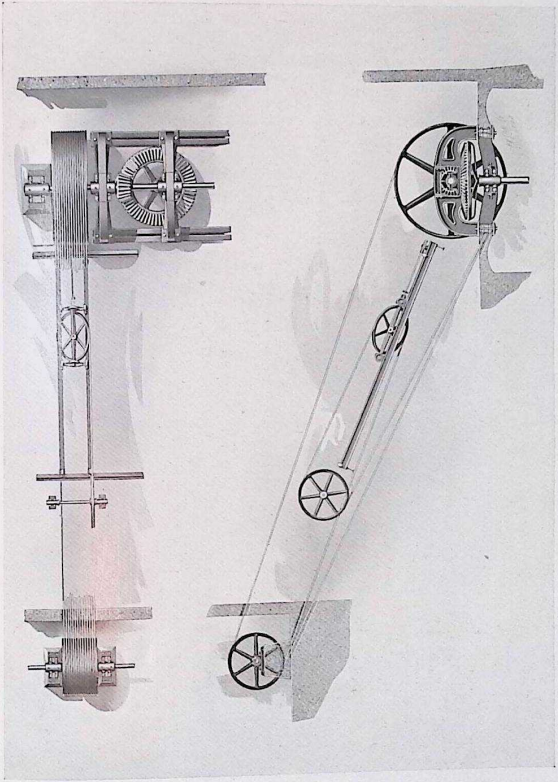


Engraving No. 344



We build hoists for operation with winch and lever, worm and worm gear or with spur or bevel gear, for single or double stems.

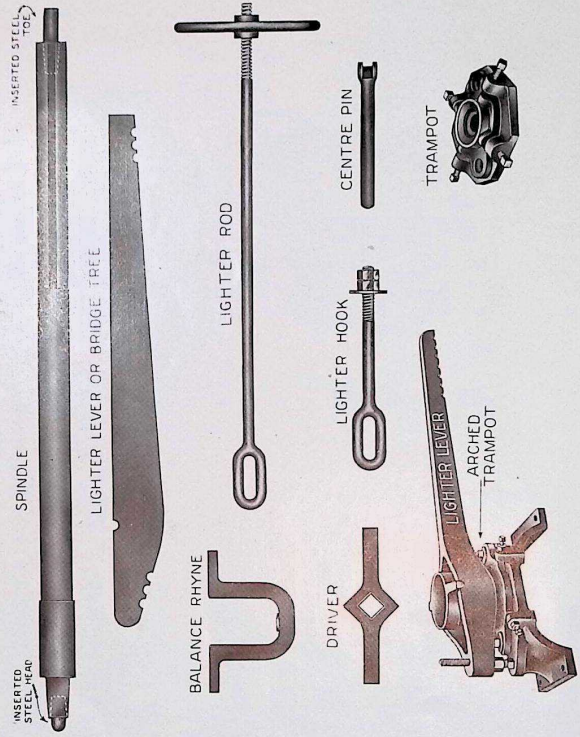
Rope Transmission



Engraving No. 345

Represents one method of transmitting the power of a vertical turbine to a line shaft by means of a pair of bevel mortise gears and a rope drive. We are prepared to furnish rope drives of every practical design.

Mill Stone Attachments



Engraving No. 346

We are prepared to furnish machinery, as shown above, for use in connection with mill stones.

Measurement of Large Streams

On streams too large to measure by weir, the quantity of water is usually determined by "float measurement." In the use of this method it is important that the float be so made that it sinks well into the water. The measurements should be taken at a point where the velocity is not too great, and where the bed of the stream is uniform. If the stream be wide, the velocity in feet per minute should be taken near the shore and in the center; the average then is the velocity of the stream.

To ascertain the cubic feet of water, multiply the depth by the width, multiply this product by the velocity in feet per minute, and the result will be the number of cubic feet flowing per minute, from which deduct 20 per cent for losses by friction, etc.

Measurement of Water Through Openings Under Pressure

Table giving the number of cubic feet of water discharged per minute, through an orifice one inch square, under any head from 3 to 62 inches.

Head	Cubic Feet	Head	Cubic Feet	Head	Cubic Feet	Head	Cubic Feet	Head	Cubic Feet	Head	Cubic Feet
3	1.12	13	2.20	23	2.91	33	3.47	43	3.95	53	4.39
4	1.27	14	2.27	24	2.97	34	3.52	44	4.00	54	4.42
5	1.41	15	2.36	25	3.03	35	3.57	45	4.05	55	4.46
6	1.53	16	2.44	26	3.09	36	3.63	46	4.10	56	4.52
7	1.64	17	2.51	27	3.15	37	3.67	47	4.13	57	4.55
8	1.75	18	2.58	28	3.20	38	3.72	48	4.18	58	4.58
9	1.85	19	2.65	29	3.26	39	3.77	49	4.22	59	4.63
10	1.94	20	2.72	30	3.32	40	3.82	50	4.27	60	4.66
11	2.03	21	2.78	31	3.37	41	3.86	51	4.30	61	4.72
12	2.12	22	2.85	32	3.42	42	3.92	52	4.34	62	4.74

EXAMPLE, SHOWING APPLICATION OF ABOVE TABLE

Suppose the opening to let the water on an overshot wheel be 36 inches long and the gate hoisted 2 inches; the head of water above opening 25 inches. Multiply the length, 36, by 2 (the height the gate is hoisted) and the result will be 72, the number of square inches in opening.

By referring to the above table, opposite 25-inch head, will be found 3.03; this multiplied by the 72 gives 218.16, the number of cubic feet of water passing through the opening per minute.

Rule for Measuring Water by Weirs

Engraving No. 347

When a water power is to be developed, the first thing to do is to measure the head and quantity of water in the stream. The following rule is generally used to ascertain the amount of water in a small stream.

Engraving No. 347 shows a weir. A is a board extending across stream with notch B, over which the water flows, beveled on down stream side. The stake at which measurements are taken is located 4 to 8 feet from weir, on up stream side, top being on a level with top notch in weir board as per line D. When the full flow of stream is passing over the weir the depth will be the distance from line D to line E (obtained by measuring on stake). The level of water surface on down stream side of weir should not be less than 8 inches below bottom of notch B in the weir board. The length of the notch B should never be less than three to four times the depth for very small streams, and longer for larger streams. See table for weir measurements on opposite page.

Table Showing the Quantity of Water Passing Over Weirs in Cubic Feet per Minute

Depth of water on weir in inch.	Cubic feet per minute passed for each foot of length of weir.	Depth of water on weir in inch.	Cubic feet per minute passed for each foot of length of weir.	Depth of water on weir in inch.	Cubic feet per minute passed for each foot of length of weir.	Depth of water on weir in inch.	Cubic feet per minute passed for each foot of length of weir.
1	4.85	4¼	50.20	8½	120.18	12½	214.32
1⅛	5.78	4⅜	52.18	8⅝	122.82	12¾	220.76
1¼	6.68	5	54.22	8¾	125.52	13	227.30
1⅜	7.80	5⅛	56.25	8⅞	128.14	13¼	233.92
1½	8.90	5¼	58.33	9	130.93	13½	240.54
1⅝	10.00	5⅜	60.42	9⅛	133.65	13¾	247.22
1¾	11.23	5½	62.55	9¼	136.43	14	254.03
1⅞	12.45	5⅝	64.68	9⅜	139.18	14¼	260.83
2	13.72	5¾	66.86	9½	141.99	14½	267.77
2⅛	15.02	5⅞	68.98	9⅝	144.80	14¾	274.70
2¼	16.36	6	71.27	9¾	147.64	15	281.72
2⅜	17.75	6⅛	73.45	9⅞	150.47	15¼	288.82
2½	19.17	6¼	75.77	10	153.35	15½	295.93
2⅝	20.63	6⅜	78.04	10⅛	156.20	15¾	303.10
2¾	22.11	6½	80.36	10¼	159.14	16	310.36
2⅞	23.63	6⅝	82.63	10⅜	162.07	16¼	317.69
3	25.20	6¾	85.04	10½	164.99	16½	325.03
3⅛	26.78	6⅞	87.43	10⅝	167.89	16¾	332.42
3¼	28.43	7	89.82	10¾	169.92	17	339.91
3⅜	30.06	7⅛	92.16	10⅞	173.90	17¼	347.45
3½	31.75	7¼	94.67	11	176.92	17½	355.02
3⅝	33.45	7⅜	97.11	11⅛	179.94	17¾	362.77
3¾	35.22	7½	99.50	11¼	182.99	18	370.34
3⅞	36.98	7⅝	102.10	11⅜	186.03	18¼	378.12
4	38.80	7¾	104.63	11½	189.13	18½	385.87
4⅛	40.63	7⅞	107.13	11⅝	192.20	18¾	393.66
4¼	42.49	8	109.74	11¾	195.32	19	401.63
4⅜	44.39	8⅛	112.31	11⅞	198.47	19¼	409.58
4½	46.29	8¼	114.91	12	201.59	19½	417.48
4⅝	48.22	8⅜	117.51	12¼	207.94	19¾	425.68

For explanation of above table and construction of Weirs see opposite page

Velocity of Water

Table giving velocity of water in feet per second, and the cubic feet of water per minute, to develop one horse-power at 80 per cent efficiency under heads from 1 to 297 feet.

Head	Velocity	Cubic Feet	Head	Velocity	Cubic Feet	Head	Velocity	Cubic Feet
1	8.02	661.765	49	56.14	13.505	97	79.00	6.822
2	11.34	330.883	50	56.71	13.236	98	79.40	6.753
3	13.89	220.589	51	57.27	12.976	99	79.81	6.685
4	16.04	165.441	52	57.84	12.726	100	80.22	6.618
5	17.92	132.353	53	58.39	12.486	101	80.61	6.552
6	19.65	110.294	54	58.93	12.255	102	81.01	6.487
7	21.22	94.538	55	59.48	12.032	103	81.40	6.425
8	22.68	82.720	56	60.01	11.817	104	81.80	6.363
9	24.06	73.529	57	60.56	11.610	105	82.19	6.303
10	25.36	66.177	58	61.08	11.410	106	82.58	6.243
11	26.60	60.160	59	61.61	11.216	107	82.97	6.185
12	27.78	55.147	60	62.12	11.029	108	83.35	6.127
13	28.92	50.905	61	62.71	10.849	109	83.74	6.071
14	30.01	47.269	62	63.15	10.674	110	84.12	6.016
15	31.06	44.118	63	63.66	10.504	111	84.50	5.962
16	32.08	41.360	64	64.16	10.340	112	84.88	5.909
17	33.07	38.927	65	64.66	10.181	113	85.25	5.857
18	34.03	36.765	66	65.16	10.027	114	85.63	5.805
19	34.96	34.830	67	65.65	9.877	115	86.00	5.755
20	35.87	33.088	68	66.14	9.732	116	86.38	5.705
21	36.75	31.513	69	66.62	9.591	117	86.75	5.656
22	37.61	30.080	70	67.11	9.454	118	87.12	5.608
23	38.46	28.772	71	67.58	9.321	119	87.49	5.561
24	39.29	27.574	72	68.06	9.191	120	87.86	5.514
25	40.10	26.471	73	68.53	9.065	121	88.22	5.469
26	40.89	25.453	74	69.00	8.943	122	88.58	5.424
27	41.67	24.510	75	69.46	8.822	123	88.94	5.380
28	42.44	23.634	76	69.92	8.707	124	89.30	5.337
29	43.19	22.819	77	70.38	8.594	125	89.66	5.294
30	43.93	22.059	78	70.84	8.484	126	90.02	5.252
31	44.65	21.347	79	71.29	8.377	127	90.38	5.211
32	45.37	20.680	80	71.74	8.272	128	90.74	5.170
33	46.07	20.053	81	72.19	8.170	129	91.09	5.130
34	46.77	19.464	82	72.63	8.070	130	91.44	5.090
35	47.45	18.908	83	73.07	7.973	131	91.79	5.051
36	48.12	18.382	84	73.51	7.878	132	92.14	5.013
37	48.78	17.886	85	73.95	7.785	133	92.49	4.976
38	49.44	17.415	86	74.38	7.695	134	92.84	4.939
39	50.09	16.968	87	74.81	7.606	135	93.19	4.902
40	50.72	16.544	88	75.24	7.520	136	93.54	4.866
41	51.35	16.141	89	75.67	7.436	137	93.88	4.830
42	51.98	15.756	90	76.09	7.353	138	94.22	4.795
43	52.59	15.390	91	76.51	7.272	139	94.56	4.761
44	53.20	15.040	92	76.93	7.193	140	94.90	4.727
45	53.80	14.706	93	77.35	7.116	141	95.23	4.693
46	54.40	14.368	94	77.76	7.040	142	95.57	4.660
47	54.99	14.080	95	78.18	6.966	143	95.90	4.627
48	55.57	13.787	96	78.59	6.893	144	96.24	4.595

Velocity of Water—Continued

Head	Velocity	Cubic Feet	Head	Velocity	Cubic Feet	Head	Velocity	Cubic Feet
145	96.57	4.563	196	112.28	3.376	247	126.05	2.679
146	96.90	4.532	197	112.57	3.359	248	126.30	2.668
147	97.23	4.501	198	112.85	3.342	249	126.56	2.657
148	97.56	4.471	199	113.14	3.325	250	126.81	2.647
149	97.89	4.441	200	113.42	3.309	251	127.07	2.636
150	98.22	4.411	201	113.70	3.292	252	127.32	2.626
151	98.53	4.382	202	113.98	3.276	253	127.57	2.616
152	98.88	4.353	203	114.26	3.259	254	127.82	2.605
153	99.20	4.325	204	114.54	3.243	255	128.07	2.595
154	99.53	4.297	205	114.82	3.227	256	128.32	2.585
155	99.85	4.269	206	115.11	3.212	257	128.57	2.575
156	100.18	4.242	207	115.39	3.196	258	128.82	2.565
157	100.50	4.215	208	115.68	3.181	259	129.07	2.555
158	100.81	4.188	209	115.95	3.166	260	129.32	2.545
159	101.13	4.162	210	116.23	3.151	261	129.57	2.535
160	101.44	4.136	211	116.50	3.136	262	129.82	2.525
161	101.75	4.110	212	116.78	3.121	263	130.07	2.515
162	102.07	4.085	213	117.05	3.106	264	130.32	2.506
163	102.38	4.060	214	117.32	3.092	265	130.57	2.497
164	102.70	4.035	215	117.59	3.077	266	130.81	2.488
165	103.01	4.010	216	117.86	3.063	267	131.06	2.478
166	103.33	3.986	217	118.13	3.049	268	131.30	2.469
167	103.64	3.962	218	118.41	3.035	269	131.55	2.460
168	103.96	3.939	219	118.68	3.021	270	131.79	2.451
169	104.27	3.915	220	118.96	3.008	271	132.04	2.442
170	104.57	3.892	221	119.22	2.994	272	132.28	2.433
171	104.88	3.869	222	119.49	2.981	273	132.52	2.424
172	105.18	3.847	223	119.75	2.967	274	132.76	2.415
173	105.49	3.825	224	120.02	2.954	275	133.00	2.406
174	105.79	3.803	225	120.30	2.941	276	133.24	2.397
175	106.10	3.781	226	120.57	2.928	277	133.49	2.388
176	106.40	3.760	227	120.85	2.915	278	133.73	2.380
177	106.70	3.739	228	121.12	2.902	279	133.98	2.371
178	107.00	3.718	229	121.38	2.889	280	134.22	2.363
179	107.30	3.697	230	121.64	2.877	281	134.46	2.354
180	107.60	3.676	231	121.90	2.864	282	134.70	2.346
181	107.90	3.656	232	122.16	2.852	283	134.94	2.338
182	108.20	3.636	233	122.42	2.840	284	135.16	2.330
183	108.50	3.616	234	122.69	2.828	285	135.40	2.321
184	108.80	3.596	235	122.95	2.816	286	135.64	2.313
185	109.09	3.577	236	123.22	2.804	287	135.88	2.305
186	109.39	3.558	237	123.47	2.792	288	136.12	2.297
187	109.68	3.539	238	123.73	2.780	289	136.36	2.289
188	109.98	3.520	239	123.98	2.768	290	136.60	2.281
189	110.27	3.501	240	124.24	2.757	291	136.84	2.273
190	110.56	3.483	241	124.50	2.745	292	137.06	2.266
191	110.85	3.464	242	124.76	2.734	293	137.29	2.258
192	111.14	3.446	243	125.02	2.723	294	137.53	2.250
193	111.42	3.429	244	125.28	2.712	295	137.76	2.242
194	111.71	3.411	245	125.54	2.701	296	138.00	2.235
195	111.99	3.393	246	125.79	2.690	297	138.23	2.227

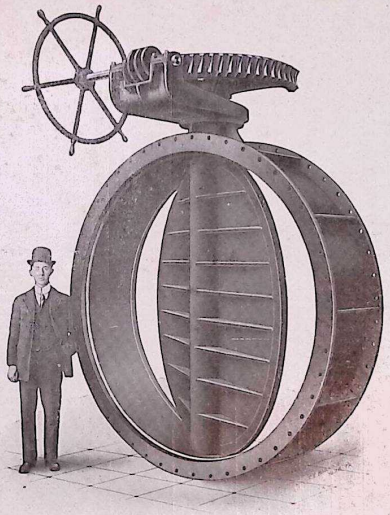
Loss in head in each 100 feet length of pipe at different velocities

Vel. in Feet Per Second	Head Required to Produce Vel.	Head Required to Overcome Loss at Ent. of Pipe	FRICTION HEAD IN FEET FOR PIPES 100 FT. LONG FROM 5.50 TO 12.00 FT. DIA. INCLUSIVE WITH CUBIC FEET DISCHARGE PER MINUTE UNDER VELOCITIES FROM 1.00 TO 12.00 FT. INCLUSIVE PER SECOND															
			5.50 Dia.		6.00 Dia.		6.50 Dia.		7.00 Dia.		8.00 Dia.		9.00 Dia.		10.00 Dia.		11.00 Dia.		12.00 Dia.	
			Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet
1.0	.01552	.00776	..	1425	..	1696	..	1991	..	2309	..	3016	..	3817	..	4712	..	5702	..	6786
1.2	.02236	.01118	.012	1711	.011	2036	..	2389	..	2771	..	3619	..	4580	..	5655	..	6842	..	8143
1.4	.03043	.01521	.015	1996	.014	2375	.013	2787	.012	3233	..	4222	..	5344	..	6597	..	7983	..	9500
1.6	.03975	.01987	.020	2281	.018	2714	.016	3186	.015	3695	.013	4825	.012	6107	.011	7540	..	9123	..	10858
1.8	.05031	.02515	.024	2566	.022	3054	.020	3584	.019	4156	.017	5429	.015	6871	.013	8482	.012	10264	.011	12215
2.0	.06211	.03105	.029	2851	.027	3393	.025	3982	.023	4618	.020	6032	.018	7634	.016	9425	.014	11404	.013	13572
2.2	.07515	.03757	.035	3136	.032	3732	.029	4380	.027	5080	.024	6635	.021	8397	.019	10367	.017	12544	.016	14929
2.4	.08944	.04472	.041	3421	.037	4071	.034	4778	.032	5542	.028	7238	.025	9161	.022	11310	.020	13685	.018	16286
2.6	.10496	.05248	.047	3706	.043	4411	.040	5177	.037	6004	.032	7841	.029	9924	.026	12252	.023	14825	.021	17644
2.8	.12173	.06086	.054	3991	.049	4750	.046	5575	.042	6465	.039	8445	.033	10688	.030	13195	.027	15966	.024	19001
3.0	.13973	.06987	.061	4276	.056	5089	.052	5973	.048	6927	.042	9048	.037	11451	.033	14137	.030	17106	.028	20358
3.2	.159	.0795	.069	4562	.063	5429	.058	6371	.054	7389	.047	9651	.042	12214	.038	15080	.034	18246	.031	21715
3.4	.1795	.08975	.077	4847	.070	5768	.065	6769	.060	7851	.053	10254	.047	12978	.042	16022	.038	19387	.035	23072
3.6	.20124	.10062	.085	5132	.078	6107	.072	7168	.067	8313	.058	10857	.052	13741	.047	16965	.042	20527	.039	24430
3.8	.22422	.11211	.094	5417	.086	6446	.079	7566	.074	8775	.065	11460	.057	14505	.052	17907	.047	21668	.043	25787
4.0	.24844	.12422	.103	5702	.094	6786	.087	7964	.081	9236	.071	12064	.063	15268	.057	18850	.051	22808	.047	27144
4.2	.27391	.13695	.113	5987	.103	7125	.095	8362	.088	9698	.077	12667	.069	16031	.062	19792	.056	23948	.051	28501
4.4	.30062	.15031	.123	6272	.112	7464	.104	8760	.097	10160	.084	13270	.075	16795	.067	20735	.061	25089	.056	29858
4.6	.32888	.16444	.133	6557	.122	7804	.113	9159	.105	10622	.092	13873	.081	17558	.073	21677	.066	26229	.061	31216
4.8	.35776	.17888	.144	6842	.132	8143	.122	9557	.113	11084	.099	14476	.088	18322	.079	22620	.072	27370	.066	32573
5.0	.38819	.19409	.155	7127	.142	8482	.131	9955	.122	11546	.107	15080	.095	19085	.085	23562	.077	28510	.071	33930
5.2	.41987	.20993	.167	7412	.153	8821	.141	10353	.131	12007	.115	15683	.102	19849	.092	24504	.083	29650	.076	35287
5.4	.45279	.22639	.179	7698	.164	9161	.151	10751	.140	12469	.123	16286	.109	20612	.098	25447	.089	30791	.082	36664
5.6	.48695	.24347	.191	7983	.175	9500	.162	11149	.150	12931	.131	16889	.117	21375	.105	26389	.095	31931	.087	38002
5.8	.52235	.26117	.204	8268	.187	9839	.172	11548	.160	13393	.140	17492	.124	22139	.112	27332	.102	33071	.093	39359
6.0	.559	.2795	.217	8553	.199	10179	.183	11946	.170	13855	.149	18095	.132	22902	.119	28274	.108	34212	.099	40716
6.2	.59689	.29844	.230	8838	.211	10518	.195	12344	.181	14316	.158	18699	.141	23666	.127	29217	.115	35352	.105	42073
6.4	.63602	.31801	.244	9123	.224	10857	.207	12742	.192	14778	.168	19302	.149	24429	.134	30159	.122	36493	.112	43430
6.6	.67639	.33819	.259	9408	.237	11197	.219	13140	.203	15240	.178	19905	.158	25192	.142	31102	.129	37633	.118	44788
6.8	.71801	.3590	.273	9693	.250	11536	.231	13539	.215	15702	.188	20508	.167	25956	.150	32044	.136	38774	.125	46145
7.0	.76086	.3843	.288	9978	.264	11875	.244	13937	.226	16164	.198	21111	.176	26719	.158	32987	.144	39914	.132	47502
7.2	.80496	.40248	.304	10263	.278	12214	.257	14335	.238	16626	.209	21714	.185	27483	.167	33929	.152	41054	.139	48859
7.4	.85031	.42515	.319	10549	.293	12554	.270	14733	.251	17087	.220	22318	.195	28246	.176	34872	.159	42195	.146	50216
7.6	.89689	.44844	.336	10834	.307	12893	.284	15131	.264	17549	.231	22921	.205	29009	.184	35814	.168	43335	.154	51574
7.8	.94472	.47236	.352	11119	.323	13232	.298	15530	.277	18011	.242	23524	.215	29773	.194	36757	.176	44475	.161	52931
8.0	.99378	.49689	.369	11404	.338	13572	.312	15928	.290	18473	.254	24127	.225	30536	.203	37699	.184	45616	.169	54288
8.2	1.04409	.52204	.386	11689	.354	13911	.327	16326	.303	18935	.266	24730	.236	31300	.212	38642	.193	46756	.177	55645
8.4	1.09565	.54782	.404	11974	.370	14250	.342	16724	.317	19396	.278	25334	.247	32063	.222	39584	.202	47897	.185	57002
8.6	1.14844	.57422	.422	12259	.387	14589	.357	17122	.332	19858	.290	25937	.258	32826	.232	40527	.211	49037	.193	58360
8.8	1.20248	.60124	.441	12544	.404	14929	.373	17521	.346	20320	.303	26540	.269	33590	.242	41469	.220	50177	.202	59717
9.0	1.25776	.62888	.459	12829	.421	15268	.389	17919	.361	20782	.316	27143	.281	34353	.253	42412	.229	51318	.210	61074
9.2	1.31428	.65714	.479	13114	.439	15607	.405	18317	.376	21244	.329	27746	.292	35117	.263	43354	.239	52458	.219	62431
9.4	1.37204	.68602	.498	13400	.456	15947	.421	18715	.391	21706	.342	28349	.304	35880	.274	44297	.249	53599	.228	63788
9.6	1.43105	.71552	.518	13685	.475	16286	.438	19113	.407	22167	.356	28953	.316	36643	.285	45239	.259	54739	.237	65146
9.8	1.49130	.74565	.538	13970	.493	16625	.455	19512	.423	22629	.370	29556	.329	37407	.296	46182	.269	55879	.247	66503
10.0	1.55279	.77639	.559	14255	.512	16964	.473	19910	.439	23091	.384	30159	.341	38170	.307	47124	.279	57020	.256	67860
10.2	1.61552	.80776	.580	14540	.532	17304	.491	20308	.456	23553	.399	30762	.354	38934	.319	48066	.290	58160	.266	69217
10.4	1.6795	.83975	.601	14825	.551	17643	.509	20706	.472	24015	.413	31365	.367	39697	.331	49009	.300	59301	.275	70574
10.6	1.74472	.87236	.623	15110	.571	17982	.527	21104	.490	24476	.428	31969	.381	40460	.343	49951	.311	60441	.285	71932
10.8	1.81118	.90559	.645	15395	.592	18322	.546	21503	.507	24938	.444	32572	.394	41224	.355	50894	.322	61581	.296	73289
11.0	1.87888	.93944	.668	15680	.612	18661	.565	21901	.525	25400	.459	33175	.408	41987	.367	51836	.334	62722	.306	74646
11.2	1.94782	.97391	.691	15965	.633	19000	.584	22299	.543	25862	.475	33778	.422	42751	.380	52779	.345	63862	.316	76003
11.4	2.01801	1.009	.714	16250	.655	19339	.604	22697	.561	26324	.491	34381	.436	43514	.393	53721	.357	65003	.327	77360
11.6	2.08944	1.04472	.737	16536	.676	19679	.624	23095	.579	26786	.507	34984	.450	44277	.405	54664	.369	66143	.338	78718
11.8	2.16211	1.08105	.762	16821	.698	20018	.644	23494	.598	27247	.524	35588	.465	45041	.419	55606	.381	67283	.349	80075
12.0	2.23602	1.11801	.786	17106	.720	20357	.665	23892	.617	27709	.540	36191	.480	45804	.432	56549	.393	68424	.360	81432

Loss in head in each 100 feet length of pipe at different velocities

Vel. in Feet Per Second	Head Required to Produce Vel	Head Required to Overcome Loss at Ent. of Pipe	FRICTION HEAD IN FEET FOR PIPES 100 FEET LONG FROM 1.00 TO 5.00 FT. DIA. INCLUSIVE WITH CUBIC FEET DISCHARGE PER MINUTE UNDER VELOCITIES FROM 1.0 TO 12.0 FT. INCLUSIVE PER SECOND.																	
			1.00 Dia.		1.50 Dia.		2.00 Dia.		2.50 Dia.		3.00 Dia.		3.50 Dia.		4.00 Dia.		4.50 Dia.		5.00 Dia.	
			Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet	Friction Head	Cubic Feet
1.0	.01552	.00776	.048	47.	.031	106.	.024	188.	.019	295.	.015	424.	....	577.	....	754.	....	954.	....	1178.
1.2	.02236	.01118	.067	56.	.044	127.	.033	226.	.026	353.	.022	509.	.019	693.	.016	905.	.014	1145.	.013	1414.
1.4	.03043	.01521	.087	66.	.057	148.	.043	264.	.034	412.	.029	594.	.024	808.	.021	1056.	.019	1336.	.017	1649.
1.6	.03975	.01987	.111	75.	.073	170.	.055	302.	.044	471.	.036	679.	.031	924.	.027	1206.	.024	1527.	.022	1885.
1.8	.05031	.02515	.136	85.	.090	191.	.068	339.	.054	530.	.045	763.	.038	1039.	.034	1357.	.030	1718.	.027	2120.
2.0	.06211	.03105	.164	94.	.109	212.	.082	377.	.065	589.	.054	848.	.046	1155.	.041	1508.	.036	1908.	.032	2356.
2.2	.07515	.03787	.195	104.	.129	233.	.097	415.	.078	648.	.064	933.	.055	1270.	.048	1659.	.043	2099.	.039	2592.
2.4	.08944	.04472	.227	113.	.151	254.	.113	452.	.090	707.	.075	1018.	.064	1385.	.057	1810.	.050	2290.	.045	2827.
2.6	.10496	.05248	.262	123.	.174	276.	.131	490.	.104	766.	.087	1103.	.074	1501.	.065	1960.	.058	2481.	.052	3063.
2.8	.12173	.06086	.300	132.	.199	297.	.150	528.	.120	825.	.099	1188.	.085	1616.	.075	2111.	.066	2672.	.060	3299.
3.0	.13975	.06987	.339	141.	.225	318.	.169	565.	.135	884.	.112	1272.	.096	1732.	.084	2262.	.075	2863.	.067	3534.
3.2	.159	.0795	.381	151.	.263	339.	.190	603.	.152	942.	.126	1357.	.108	1847.	.095	2413.	.084	3054.	.076	3770.
3.4	.1795	.08975	.425	160.	.283	360.	.212	641.	.170	1001.	.141	1442.	.121	1963.	.106	2563.	.094	3244.	.085	4006.
3.6	.20124	.10062	.471	170.	.313	382.	.235	679.	.188	1060.	.156	1527.	.134	2078.	.117	2714.	.104	3435.	.094	4241.
3.8	.22422	.11211	.520	179.	.346	403.	.260	716.	.208	1119.	.173	1612.	.148	2194.	.130	2865.	.115	3626.	.104	4477.
4.0	.24844	.12422	.570	188.	.379	424.	.285	754.	.228	1178.	.189	1697.	.162	2309.	.142	3016.	.126	3817.	.114	4712.
4.2	.27391	.13695	.623	198.	.415	445.	.311	791.	.249	1237.	.207	1781.	.177	2425.	.155	3167.	.138	4008.	.124	4948.
4.4	.30062	.15031	.678	207.	.452	467.	.339	829.	.271	1296.	.226	1866.	.193	2540.	.169	3317.	.150	4199.	.135	5184.
4.6	.32888	.16444	.736	217.	.490	488.	.368	867.	.294	1355.	.245	1951.	.210	2655.	.184	3468.	.163	4390.	.147	5419.
4.8	.35776	.17888	.795	226.	.529	509.	.397	905.	.318	1414.	.264	2036.	.227	2771.	.198	3619.	.176	4580.	.159	5655.
5.0	.38819	.19409	.856	236.	.570	530.	.428	942.	.342	1473.	.285	2121.	.244	2886.	.214	3770.	.190	4771.	.171	5891.
5.2	.41987	.20993	.920	245.	.613	551.	.46	980.	.368	1532.	.306	2205.	.262	3002.	.230	3921.	.204	4962.	.184	6126.
5.4	.45279	.22639	.986	254.	.657	573.	.493	1018.	.394	1590.	.328	2290.	.281	3117.	.246	4071.	.219	5153.	.197	6362.
5.6	.48695	.24347	1.05	264.	.702	594.	.527	1056.	.421	1649.	.351	2375.	.301	3233.	.263	4222.	.234	5344.	.210	6597.
5.8	.52235	.26117	1.12	273.	.749	615.	.564	1093.	.449	1708.	.374	2460.	.321	3348.	.281	4373.	.249	5535.	.224	6833.
6.0	.559	.279	1.19	283.	.797	636.	.598	1131.	.478	1767.	.398	2545.	.340	3464.	.299	4524.	.265	5725.	.239	7069.
6.2	.59689	.29844	1.27	292.	.846	657.	.635	1169.	.508	1826.	.423	2630.	.362	3579.	.317	4675.	.282	5916.	.254	7304.
6.4	.63602	.31801	1.34	302.	.897	679.	.673	1206.	.538	1885.	.448	2714.	.384	3695.	.336	4825.	.299	6107.	.269	7540.
6.6	.67639	.33819	1.42	311.	.949	700.	.712	1244.	.570	1944.	.474	2799.	.407	3810.	.356	4976.	.316	6298.	.285	7775.
6.8	.71801	.35900	1.50	320.	1.00	721.	.753	1282.	.602	2003.	.501	2884.	.430	3925.	.376	5127.	.334	6489.	.301	8011.
7.0	.76086	.38043	1.58	330.	1.05	742.	.794	1319.	.635	2062.	.529	2969.	.453	4041.	.397	5278.	.352	6680.	.317	8247.
7.2	.80496	.40248	1.67	339.	1.11	763.	.836	1357.	.669	2121.	.557	3054.	.477	4156.	.418	5429.	.371	6871.	.334	8482.
7.4	.85031	.42515	1.76	349.	1.17	785.	.880	1395.	.704	2179.	.586	3138.	.502	4272.	.440	5579.	.391	7061.	.352	8718.
7.6	.89689	.44844	1.84	358.	1.23	806.	.924	1433.	.739	2238.	.616	3223.	.528	4387.	.462	5830.	.410	7252.	.369	8954.
7.8	.94472	.47236	1.94	368.	1.29	827.	.970	1470.	.776	2297.	.646	3308.	.554	4503.	.485	5881.	.431	7443.	.388	9189.
8.0	.99378	.49689	2.03	377.	1.35	848.	1.01	1508.	.813	2356.	.677	3393.	.580	4618.	.508	6032.	.451	7634.	.406	9425.
8.2	1.04409	.52204	2.12	386.	1.41	869.	1.06	1546.	.851	2415.	.709	3478.	.607	4734.	.532	6182.	.472	7825.	.425	9660.
8.4	1.09565	.54782	2.22	396.	1.48	891.	1.11	1583.	.890	2474.	.741	3563.	.635	4849.	.556	6333.	.494	8016.	.445	9896.
8.6	1.14844	.57422	2.32	405.	1.54	912.	1.16	1621.	.930	2533.	.774	3647.	.664	4964.	.581	6484.	.516	8206.	.465	10132.
8.8	1.20248	.60124	2.42	415.	1.61	933.	1.21	1659.	.970	2592.	.808	3732.	.693	5080.	.606	6635.	.539	8397.	.485	10367.
9.0	1.25776	.62888	2.53	424.	1.68	954.	1.26	1696.	1.01	2651.	.843	3817.	.722	5195.	.632	6786.	.562	8588.	.506	10603.
9.2	1.31428	.65714	2.63	434.	1.75	975.	1.31	1734.	1.05	2710.	.878	3902.	.752	5311.	.658	6936.	.585	8779.	.527	10839.
9.4	1.37254	.68602	2.74	443.	1.82	997.	1.37	1772.	1.09	2769.	.913	3987.	.783	5426.	.685	7087.	.609	8970.	.548	11074.
9.6	1.43205	.71552	2.85	452.	1.90	1018.	1.42	1809.	1.14	2827.	.950	4072.	.814	5542.	.713	7238.	.633	9161.	.570	11310.
9.8	1.49130	.74565	2.96	462.	1.97	1039.	1.48	1847.	1.18	2886.	.987	4156.	.846	5657.	.741	7389.	.658	9352.	.592	11545.
10.	1.55279	.77639	3.07	471.	2.05	1060.	1.53	1885.	1.23	2945.	1.02	4241.	.879	5773.	.769	7540.	.683	9542.	.615	11781.
10.2	1.61552	.80776	3.19	481.	2.12	1081.	1.59	1923.	1.27	3004.	1.06	4326.	.912	5888.	.798	7690.	.709	9733.	.638	12017.
10.4	1.6795	.83975	3.31	490.	2.20	1103.	1.65	1960.	1.32	3063.	1.10	4411.	.945	6004.	.827	7841.	.735	9924.	.662	12252.
10.6	1.74472	.87236	3.43	500.	2.28	1124.	1.71	1998.	1.37	3122.	1.14	4496.	.980	6119.	.857	7992.	.762	10115.	.686	12488.
10.8	1.81118	.90559	3.55	509.	2.36	1145.	1.77	2036.	1.42	3181.	1.18	4580.	1.01	6234.	.888	8143.	.789	10306.	.710	12723.
11.0	1.87888	.93944	3.67	518.	2.45	1166.	1.83	2073.	1.47	3240.	1.22	4665.	1.05	6350.	.919	8294.	.816	10497.	.735	12959.
11.2	1.94782	.97391	3.80	528.	2.53	1187.	1.90	2111.	1.52	3299.	1.26	4750.	1.08	6465.	.950	8444.	.844	10687.	.760	13195.
11.4	2.01801	1.009	3.93	537.	2.62	1209.	1.96	2149.	1.57	3358.	1.31	4835.	1.12	6580.	.982	8595.	.873	10878.	.786	13430.
11.6	2.08944	1.04472	4.05	547.	2.70	1230.	2.02	2187.	1.62	3416.	1.35	4920.	1.15	6696.	1.01	8746.	.901	11069.	.811	13666.
11.8	2.16211	1.08105	4.19	556.	2.79	1251.	2.09	2224.	1.67	3475.	1.39	5005.	1.19	6812.	1.04	8897.	.931	11260.	.838	13902.
12.0	2.23602	1.11801	4.32	565.	2.88	1272.	2.16	2262.	1.73	3534.	1.44	5089.	1.23	6927.	1.08	9048.	.961	11451.	.865	14137.

Flutter Gates



Engraving No. 348

We build Flutter Gates of this design of any size and for any head.

They can be built with bell ends when desired. They are so built that the leakage is comparatively small.